(2)

Bank Conditions and Recession Along the U.S. Shorelines of the St. Marys, St. Clair, Detroit and St. Lawrence Rivers: Ancillary Data

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February 1982

Prepared for the
U.S. Army Engineer District, Detroit

Corps of Engineers
U.S. Army Cold Regions Research and Engineering Laboratory
72 Lyme Road
Hanover, NH 03755

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REPORT DOCUMENTATION PAGE

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This Internal Report contains information for a large volume of detailed, site-specific field data and photographs collected to characterize the bank conditions and changes reported in CRREL Report 82-11. The data are presented by river to conform to the CRREL report. The analysis of bank conditions and recession along the shorelines of the St. Marys, St. Clair, Detroit, and St. Lawrence Rivers was done from 1977 to 1980.

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The analysis of bank conditions and recession along the shorelines of the St. Marys, St. Clair, Detroit and St. Lawrence Rivers was done from 1977 to 1980 (Fig. 1). As part of that analysis, a large volume of detailed, site-specific field data and photographs were collected to characterize the bank conditions and changes reported in CRREL Report 82-11. This Internal Report contains this information. The data are presented by river to conform to the CRREL Report. This Internal report does not contain analysis of these data.

During the initial boat survey of the Detroit River, the shoreline of Lake St. Clair (Fig. 2) was observed from Grosse Point Yacht Club to Windmill Point. This shoreline was protected with various types of structures, primarily bulkheads or seawalls. The remainder of the U.S. portion of the lakeshore is greater than three miles away from the navigation channel, well beyond the zone influenced by passing ships (Tomandl, pers. comm. 1977). Consequently, none of the Lake St. Clair shoreline was monitored during the later boat surveys.

Bank soils maps adapted from the Soil Conservation Service (SCS) soil surveys were prepared for the St. Marys and St. Clair Rivers (Fig. 3) to provide additional data on bank composition. I did not prepare soils maps for the Detroit or St. Lawrence Rivers. The soil series have not been mapped for Wayne County along the Detroit River (Fig. 3). The SCS mapped only the four regional soil associations for a reconnaissance soil survey. The reconnaissance survey map is too general to provide useful information on bank soil characteristics along the Detroit River.

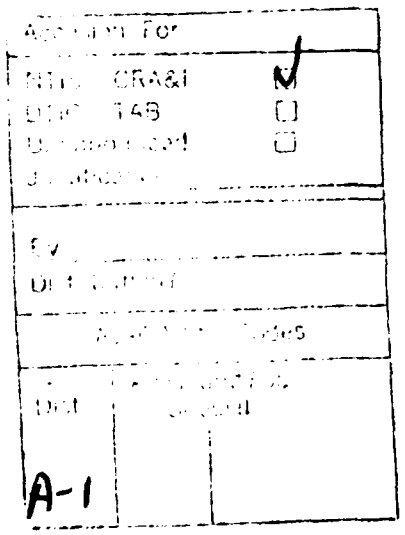
At the time of this project, soil series information was available only for Franklin County and most of St. Lawrence County along the St.

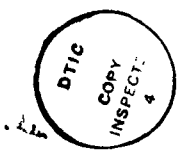
Lawrence River; the SCS had not completed the mapping for Jefferson County. For soils information along the St. Lawrence River, the St. Lawrence-Eastern Ontario Commission (1977) discussed bank erosion potential using soils data and provided a good inventory of shoreline structures and an estimate of the amount of receding bankline along the St. Lawrence River.

I described beach characteristics, bank composition, evidence for bank erosion due to surface runoff or groundwater seepage, land use, and upstream, downstream and nearshore conditions along reaches with eroding banks that were representative of the eroding banks along each river. I also prepared river cross sections for the eroding reaches that are representative of the general river bottom topography between the reaches and the navigation channel. These cross sections were drawn from and the distances to the channel were measured on navigation charts and topographic maps.

Reference

St. Lawrence - Eastern Ontario Commission (1977) Evaluation of shore structures and shore erodibility, St. Lawrence River, New York State. Contract report prepared for the St. Lawrence Seaway Development Corporation, Massena, New York.





MILESTONES	FY77			FY78				FY79				FY80		
	2	3	4	1	2	3	4	1	2	3	4	1	2	3
Literature review	▲													
Search, select, acquire and assemble historical aerial photography	■	■	■	■	■	■	■							
Project review and coordination meetings	▲	▲	▲											
Aerial reconnaissance surveys														
St. Marys River (4 Feb 77)	▲													
St. Clair/Detroit Rivers (1 Feb 77)	▲													
St. Lawrence River (__ Oct 77)				▲										
Field surveys														
St. Marys River		▲ 5/25,26		▲ 10/20,21		▲ 5/22,23		▲ 11/2,3		▲ 5/17,18		▲ 10/5,6		▲ 5/27 28
St. Clair River		▲ 5/23		▲ 10/18		▲ 5/20		▲ 10/30,31		▲ 5/19		▲ 10/1		▲ 5/29
Detroit River		▲ 5/23,24		▲ 10/19		▲ 5/21		▲ 10/30		▲ 5/20		▲ 10/3		▲ 5/30
St. Lawrence River				▲ 11/16,17		▲ 5/16 17 18		▲ 10/27 28 29				▲ 10/1,2		
Acquire large-scale (1:5,000) aerial photography														
St. Marys River				▲ 10/9		▲ 5/21		▲ 10/20		▲ 5/21				
St. Clair River				▲ 10/10		▲ 5/22		▲ 10/21		▲ 5/22,29				
Detroit River				▲ 10/10		▲ 5/23		▲ 10/21		▲ 5/29				
St. Lawrence River				▲ 10/11		▲ 5/24		▲ 10/22		▲ 5/31 6/17				

Remarks *Quarters: 1 = Oct-Dec
2 = Jan-Mar
3 = Apr-Jun
4 = July-Sept

MILESTONES	FY77			FY78				FY79				FY80		
	2	3	4	1	2	3	4	1	2	3	4	1	2	3
In-house photographic processing				▬	▬	▬	▬	▬	▬	▬	▬			
Prepare thematic maps, data analysis, photointerpretation and measure historical changes		▬	▬	▬	▬	▬	▬	▬	▬	▬	▬	▬		▲
Presentations														
ASP Fall Technical Meeting (15-20 Oct 78)								▲						
CE Remote Sensing Symposium (29-31 Oct 79)												▲		
Interim reports														
Progress Report (Aug 77)			▲											
CRREL Internal Report 553 (Apr 78)						▲								
Proceedings, ASP (Oct 78)								▲						
CRREL Internal Report 589 (Nov 78)								▲						
CRREL Internal Report 590 (Feb 79)									▲					
Proceedings, CE Symposium (Oct 79)												▲		

Remarks

Figure 1. (continued).

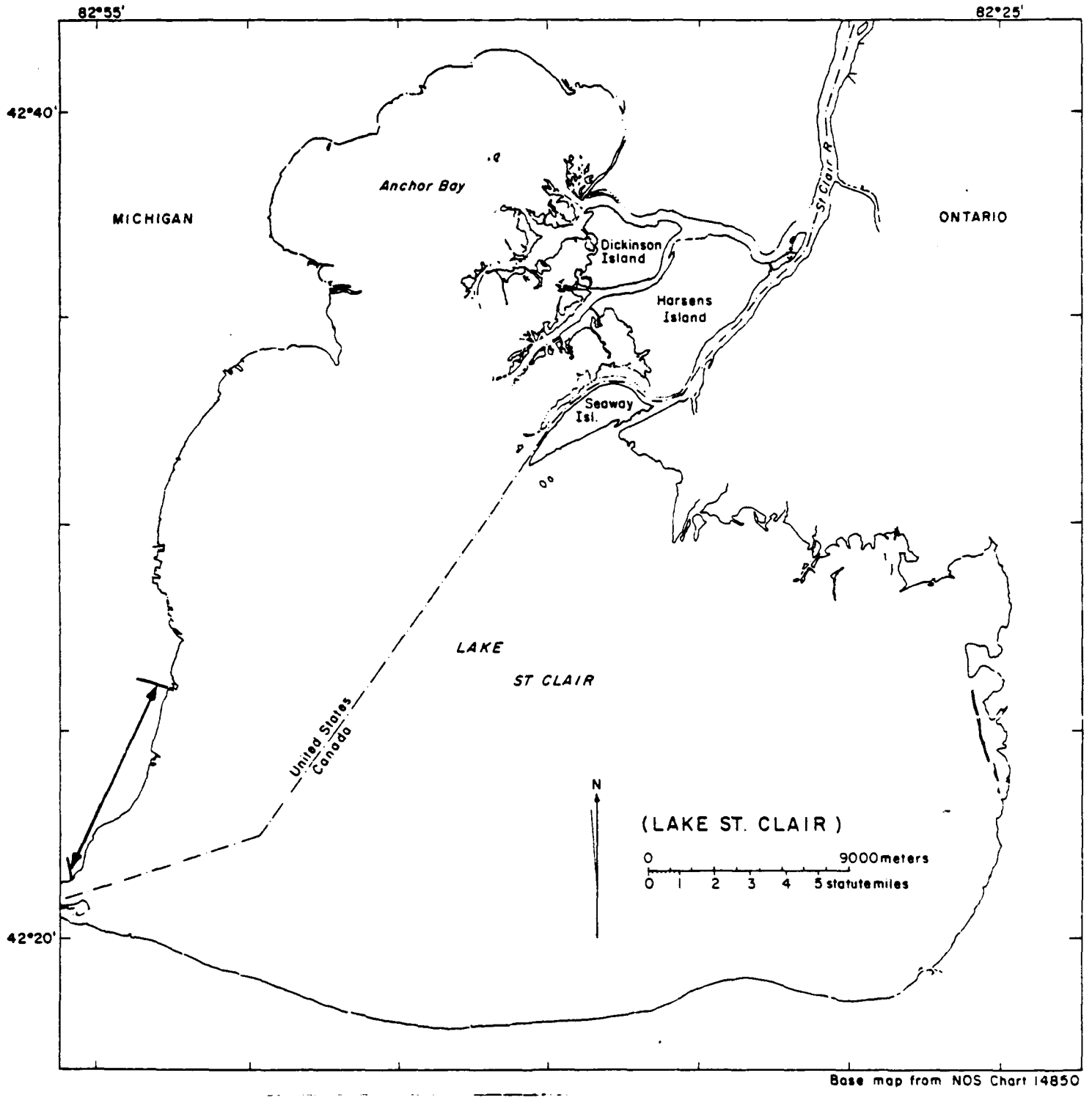


Figure 2. Surveyed portion of Lake St. Clair

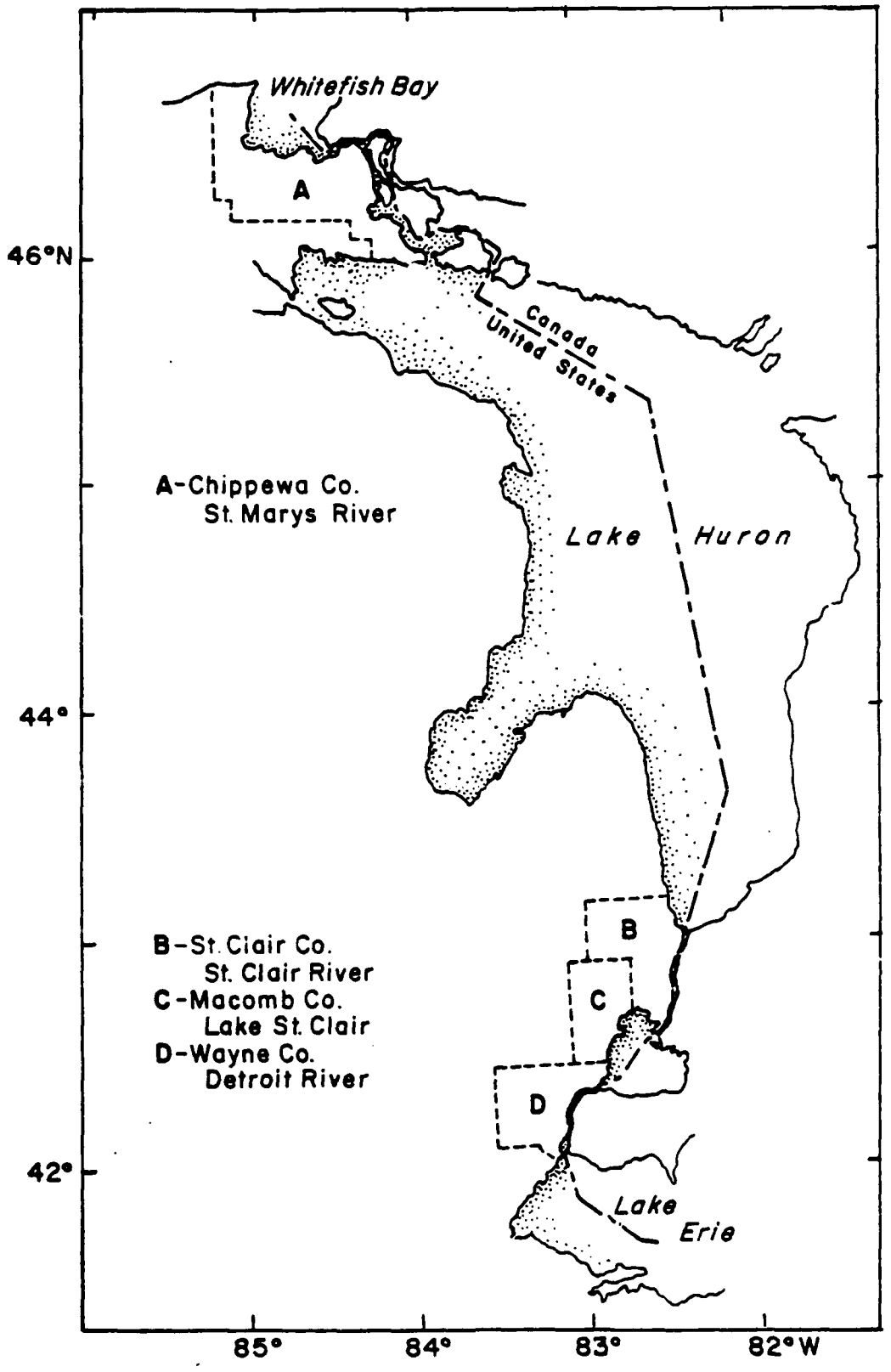
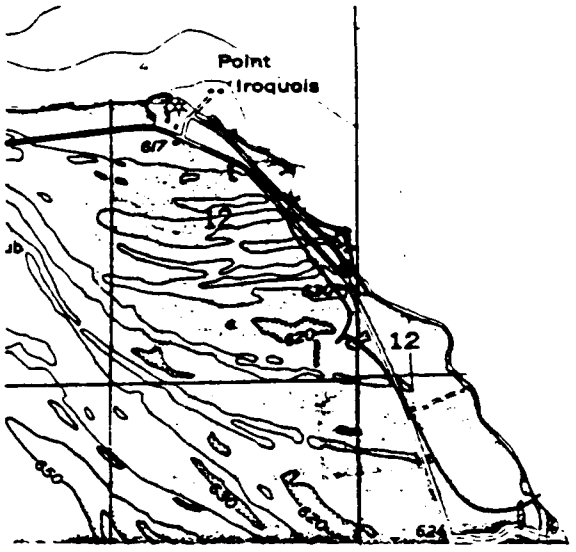


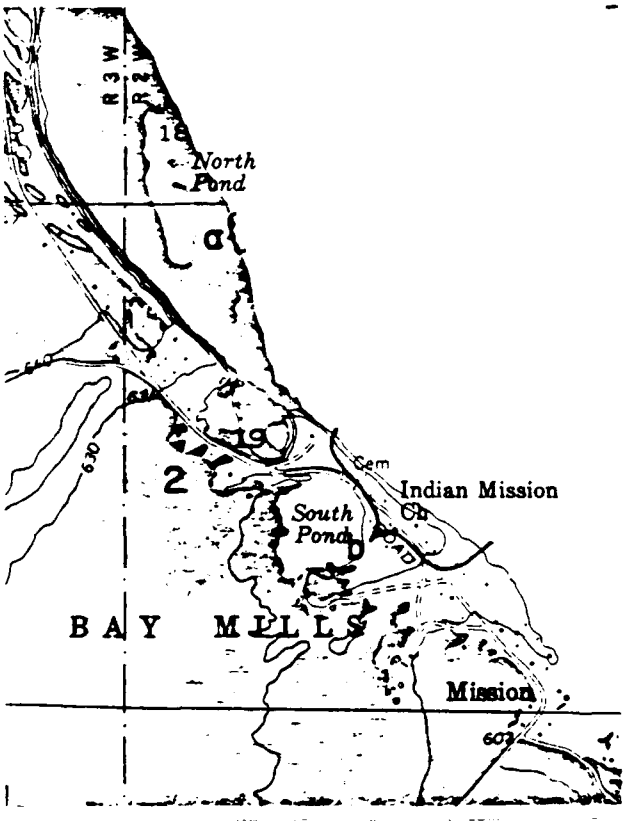
Figure 3. County locations of soil surveys.

St. Marys River

Locations of partially vegetated and bare banks (shown on portions of U.S.G.S. 7-1/2 minute-series topographic maps).



SMR site 1 (Dollar Settlement, Mich., 1951, and Brimley, Mich., 1975)



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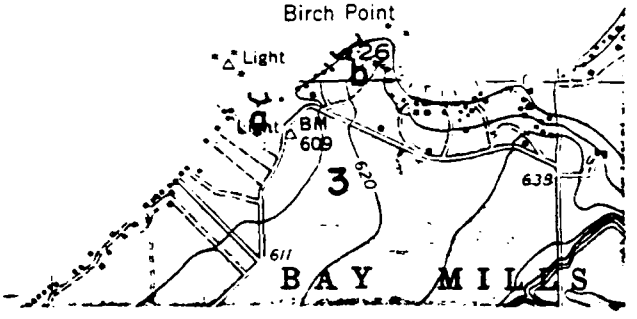
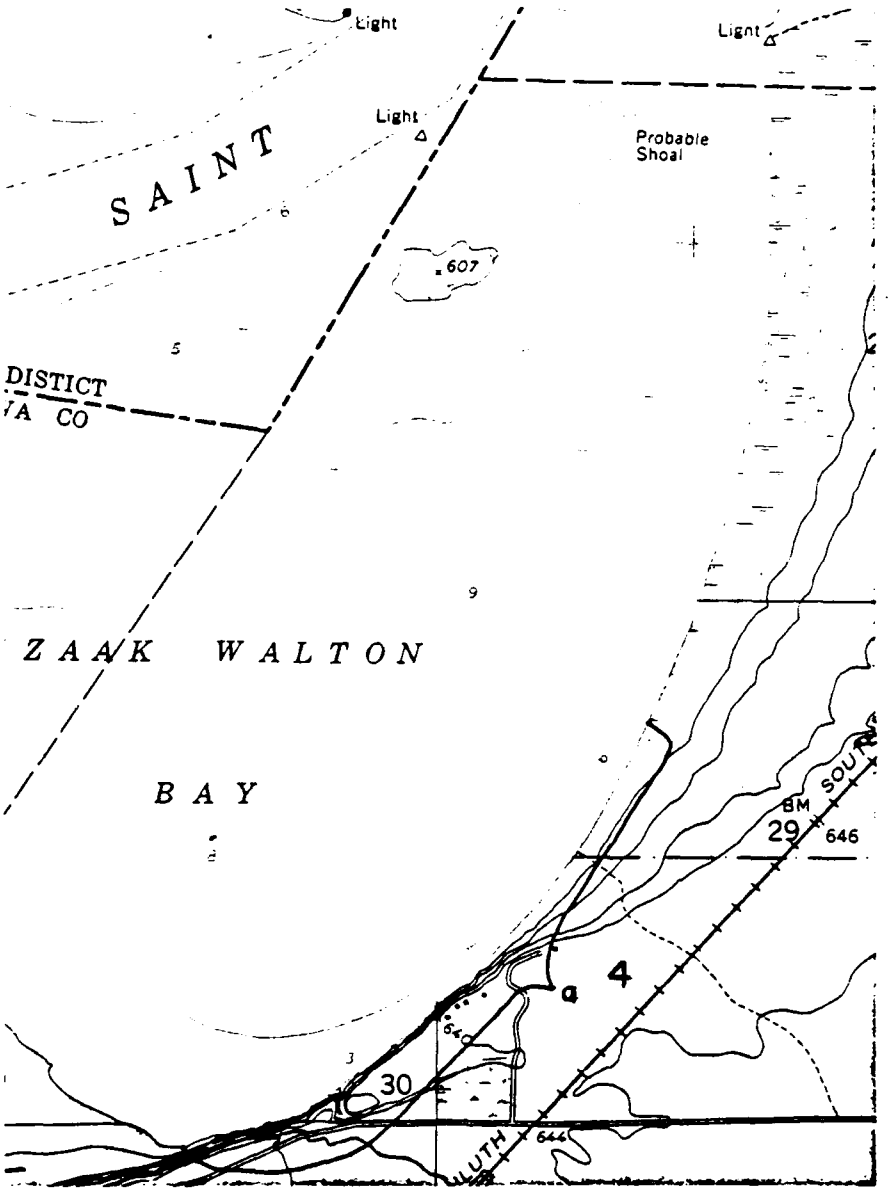
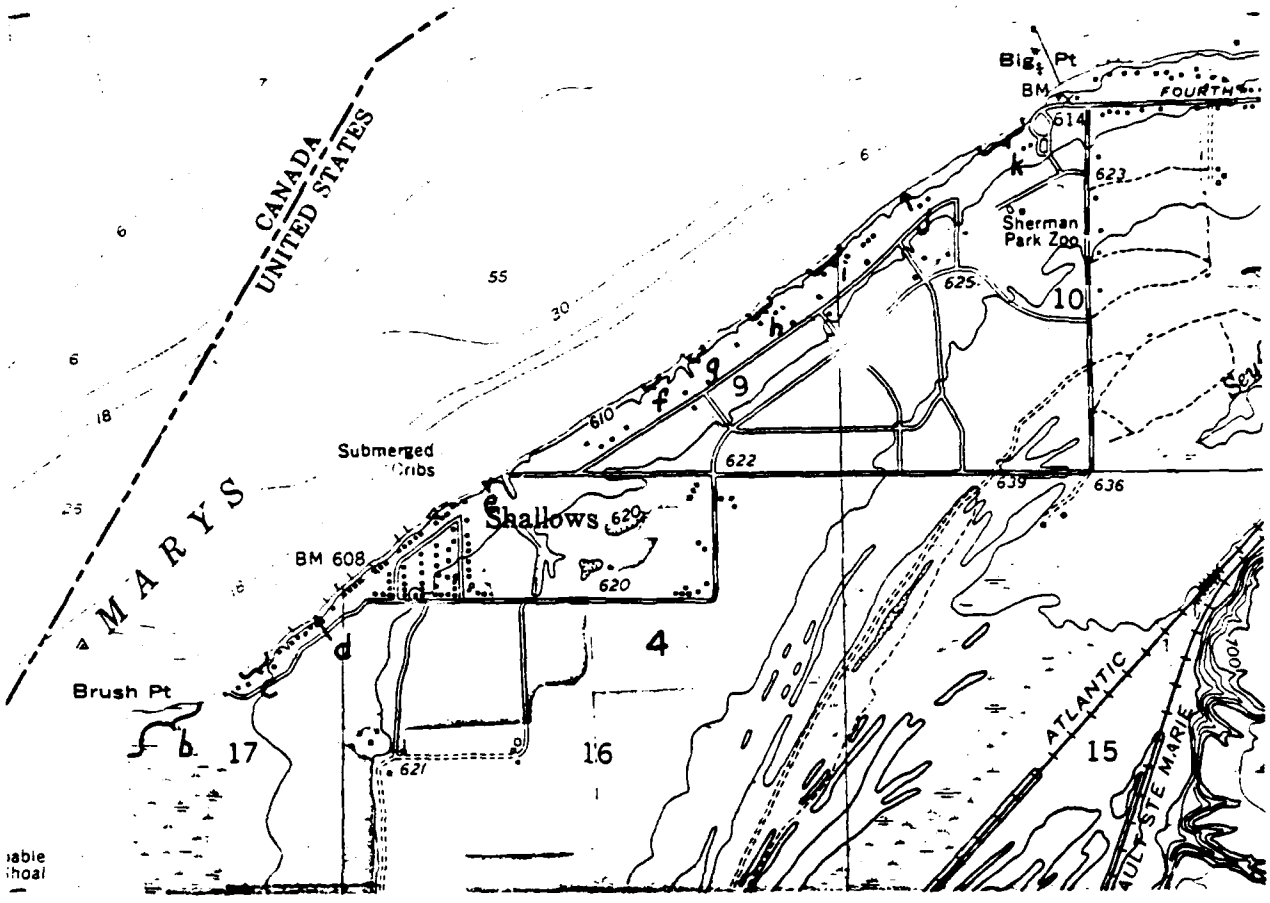


SMR site 3 (Brimley, Mich., 1975)



SMR site 4, west (Shallows, Mich., 1951)



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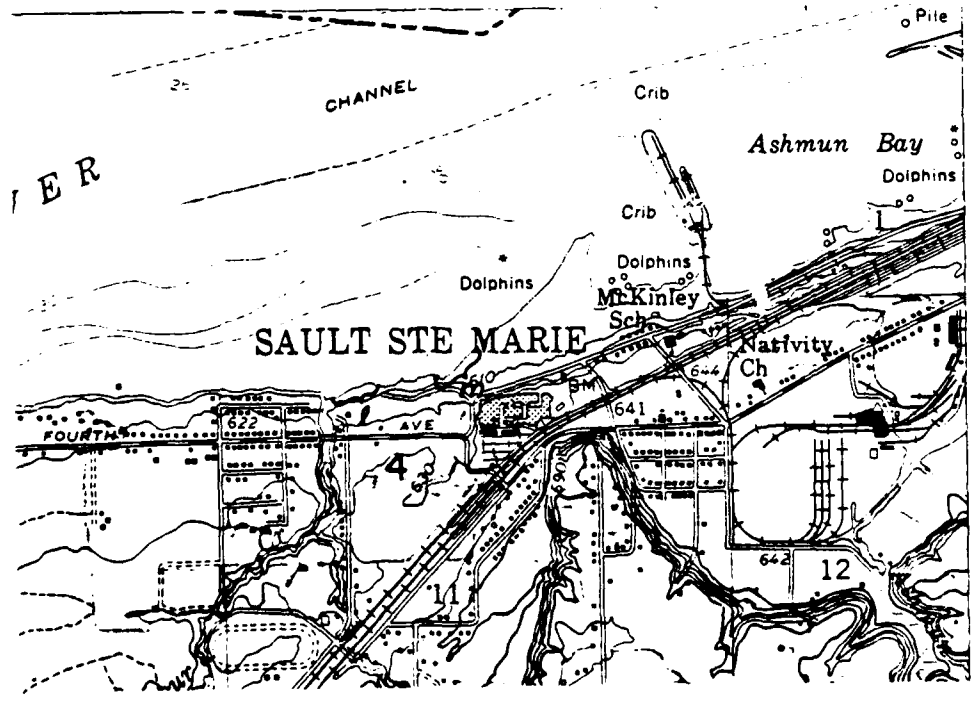
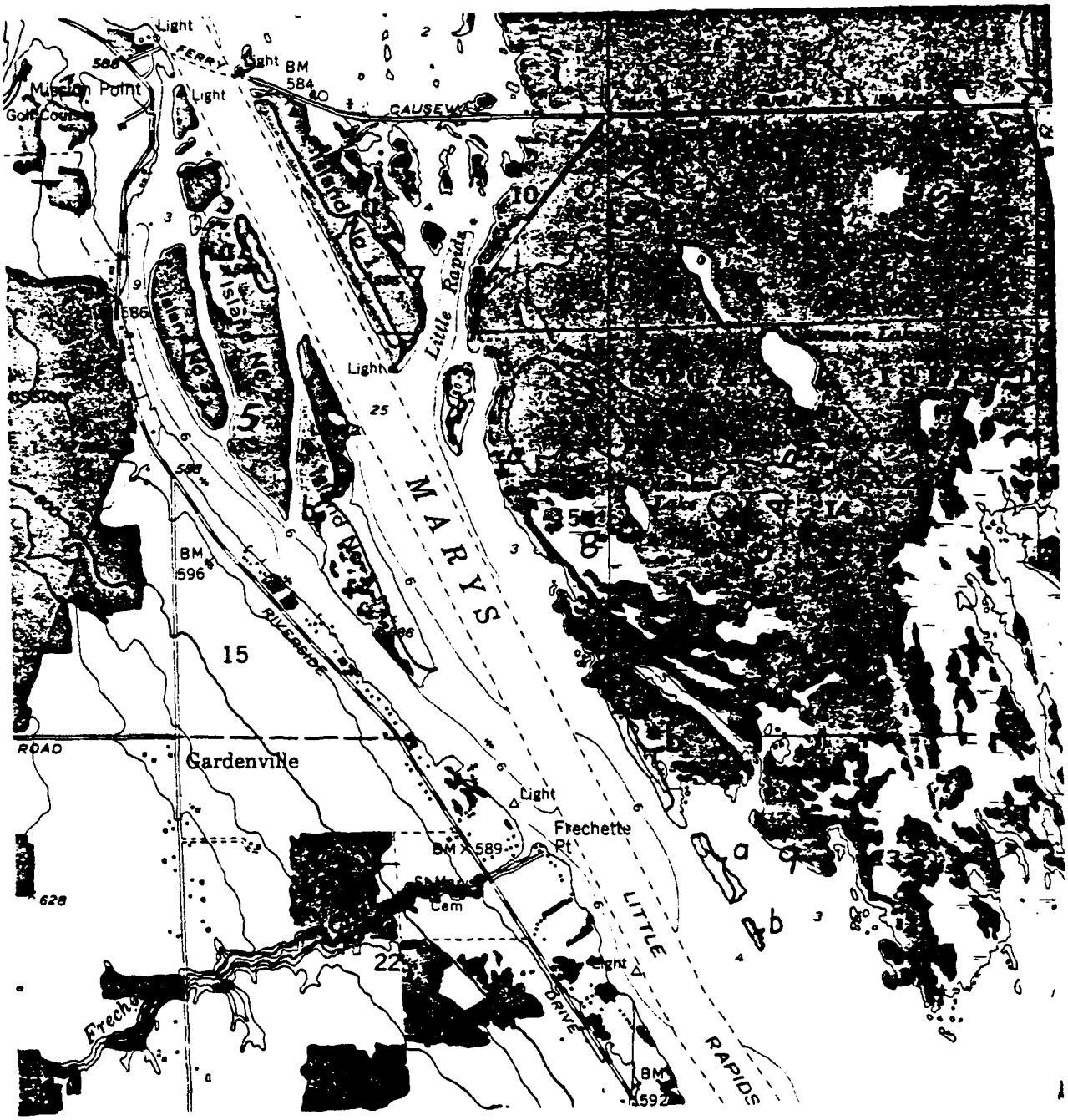
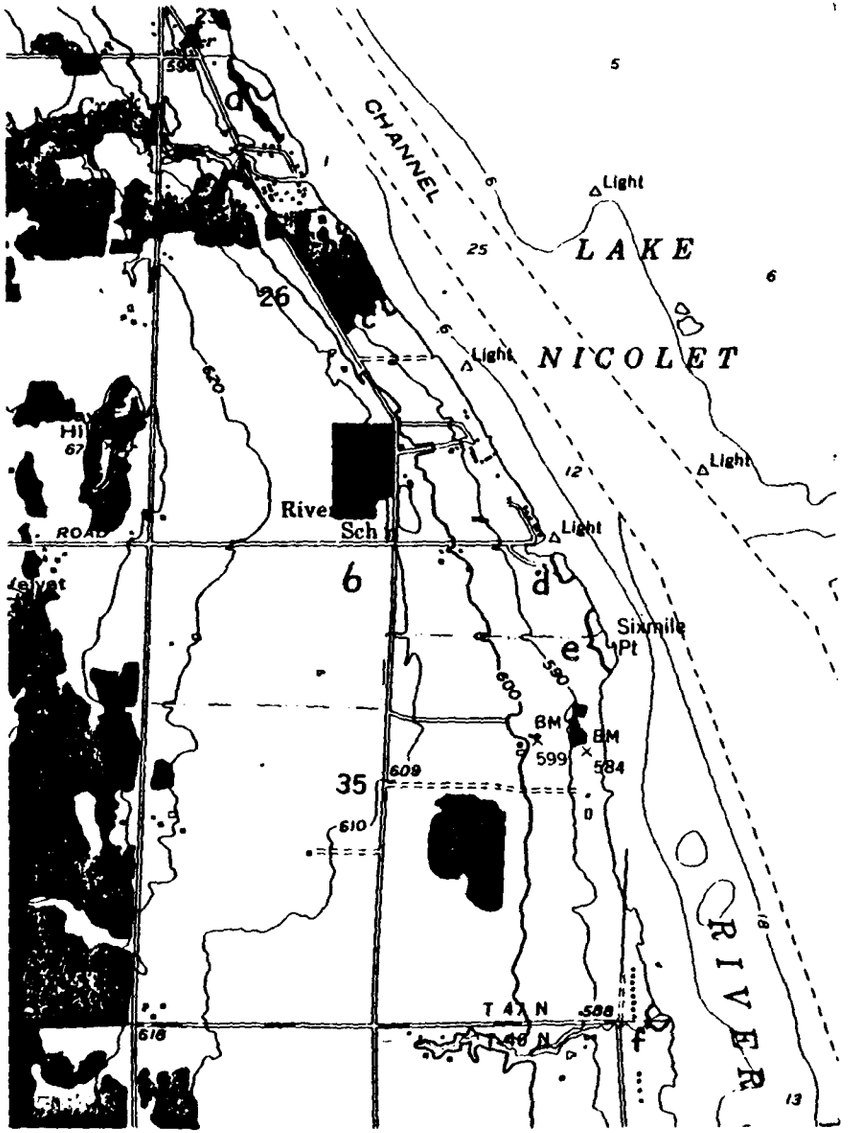




SMR sites 5, 7, 8, and 9 (Sault Ste. Marie South, Mich., 1951)



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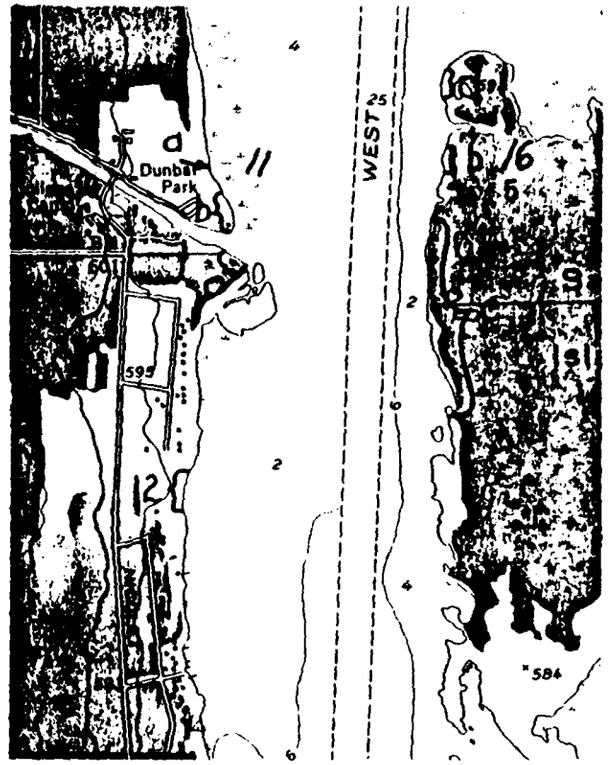
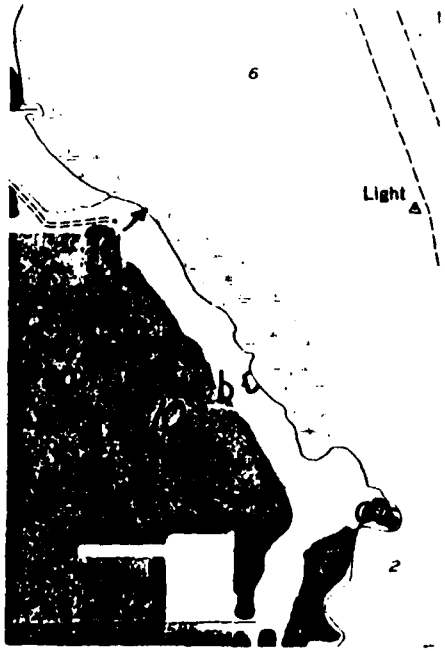
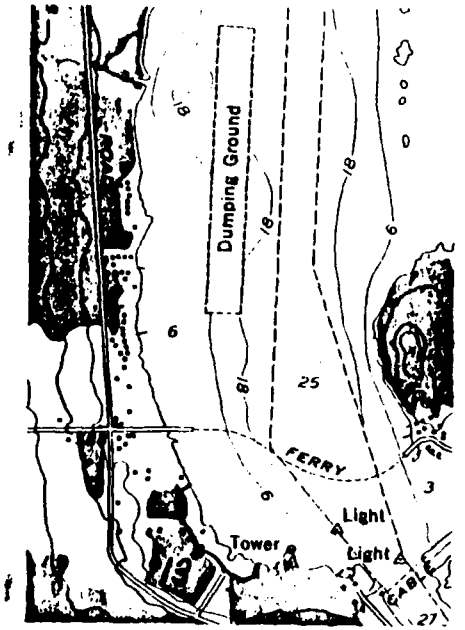


SMR sites 11, 12, and 16 (Oak Ridge, Mich., 1951)



SMR site 10 (Oak Ridge, Mich., 1951)



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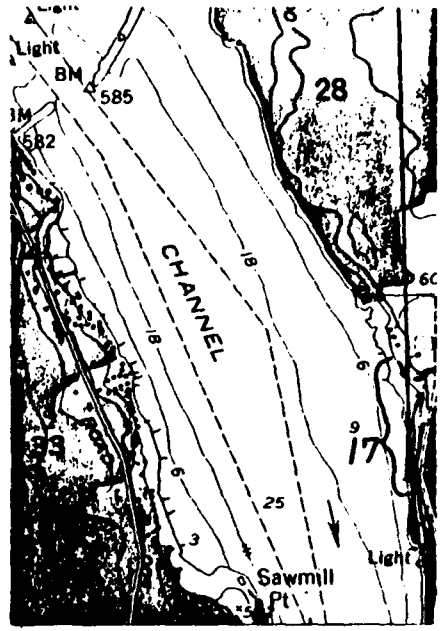
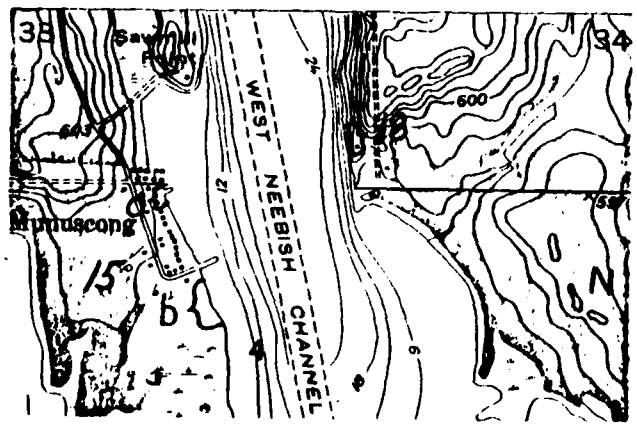
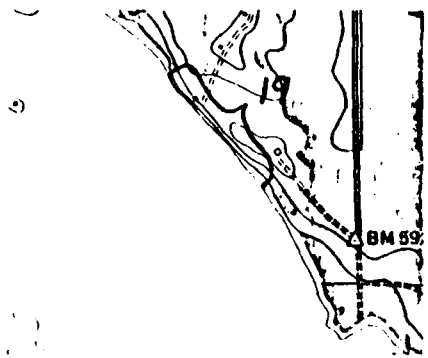


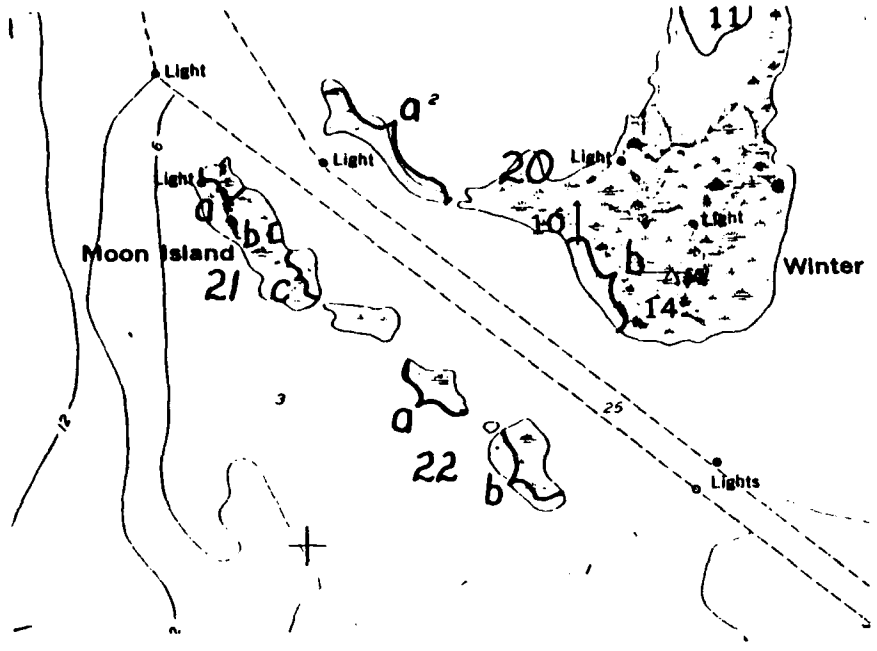
SMR sites 14 and 17
(Oak Ridge, Mich., 1951)



SMR sites 15 and 18 (Munuscong, Mich., 1953)



SMR site 19 (Munusc..., Mich., 1953)



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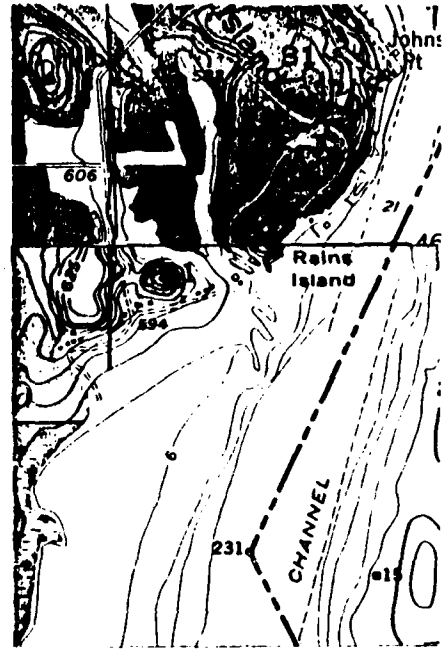
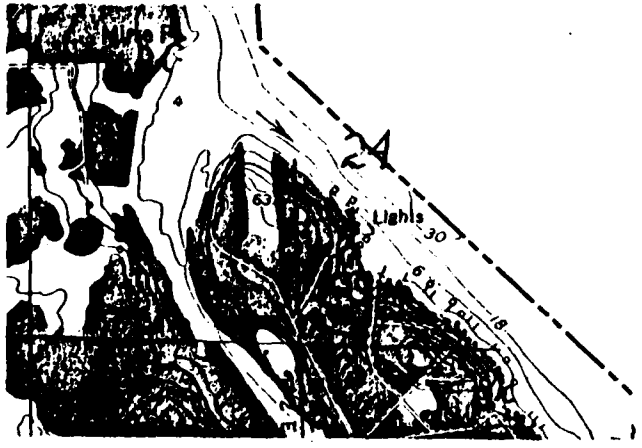


SMR site 23 (Oak Ridge, Mich., 1951, and Munuscong NE, Mich., 1953)



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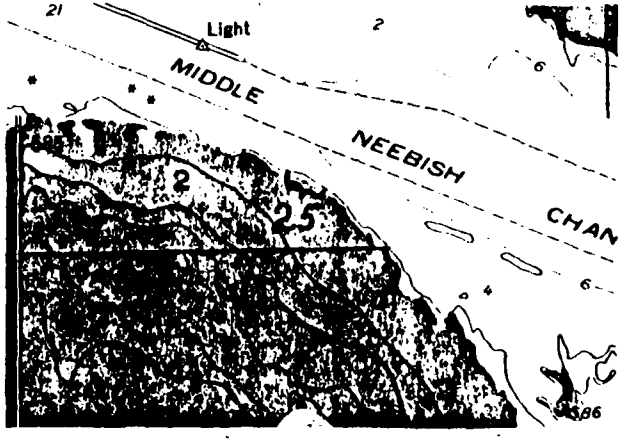

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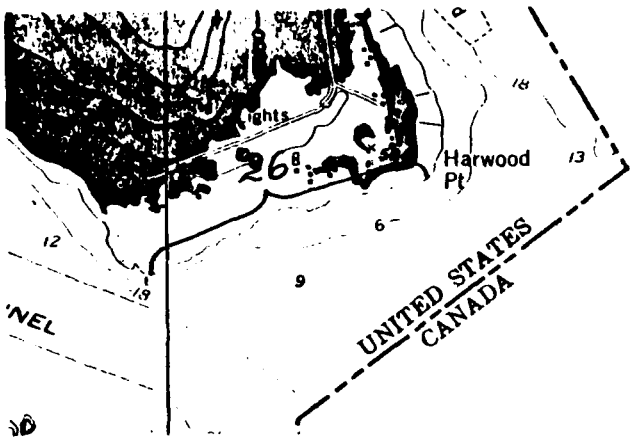
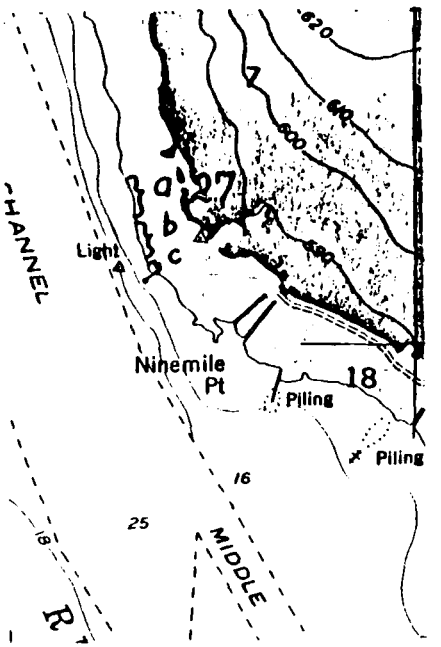
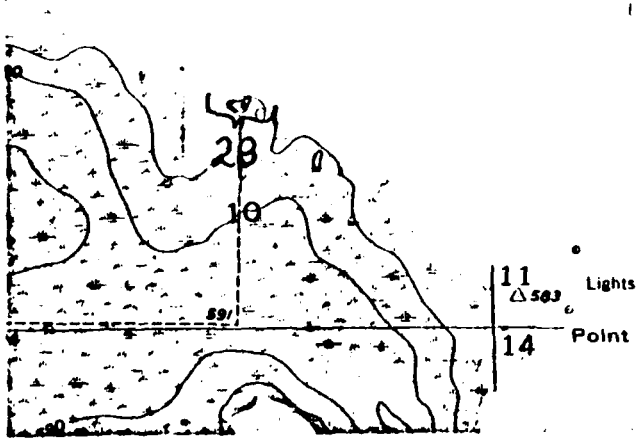


SMR site 26 (Oak Ridge, Mich., 1951)



SMR site 27 (Baie De Wasai, Mich., 1951)



SMR site 28 (Munuscong NE, Mich., 1953)

St. Marys River

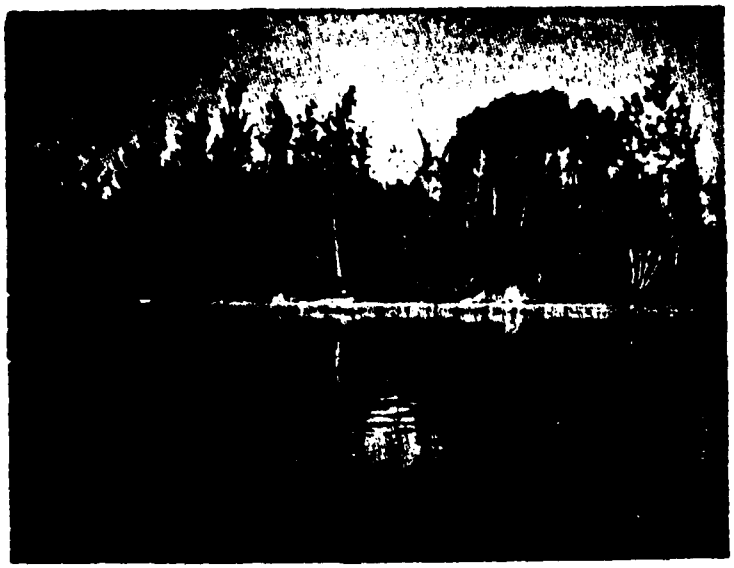
Selected photographs that illustrate the diversity of the eroding banks; not all eroding banks are shown.

SMR reach 4i, 26 May 77

SMR reach 4k, 26 May 77

SMR reach 5a, 2 Nov 78

SMR reach 5a, 25 May 77



SMR reach 5b, 25 May 77

SMR reach 6a, 20 Oct 77

SMR reach 6c, 23 May 78

SMR reach 6e, 20 Oct 77.

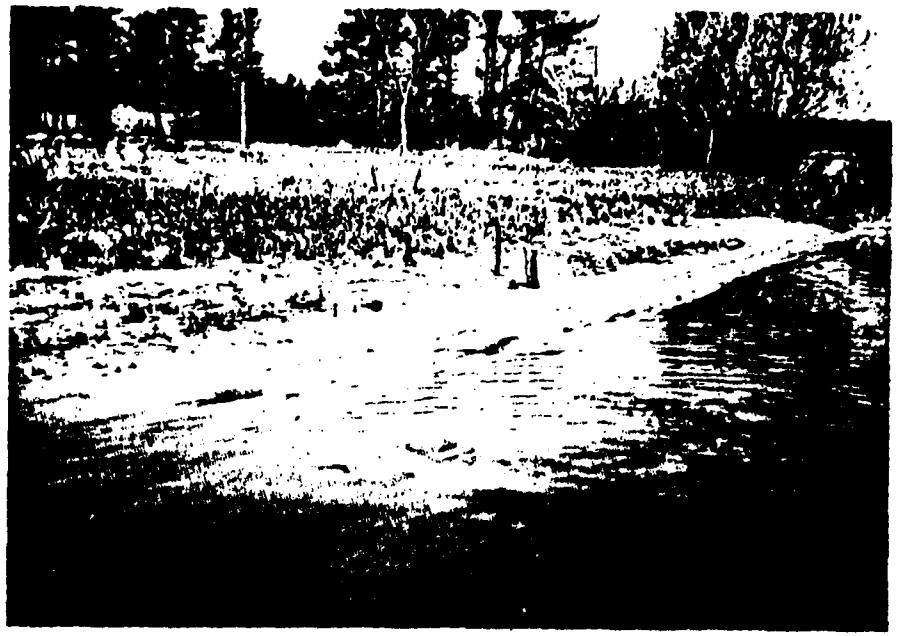
SMR reach 7a, 25 May 77

SMR reach 7b, 25 May 77

SMR reach 8b, 25 May 77

SMR reach 9a, 20 Oct 77

SMR reach 9b, 27 May 80



SMR reach 11b, 22 May 78

SMR reach 11b, 22 May 78

SMR reach 11c, 2 Nov 78

SMR reach 16a, 2 Nov 78

SMR reach 16b, 2 Nov 78

SMR reach 16c, 27 May 80

SMR site 18, 25 May 78

SMR site 19, 20 Oct 77

SMR reach 20a, 25 May 77

SMR reach 21a, 27 May 80

SMR reach 21b, 25 May 77

SMR reach 21c, 25 May 77

SMR reach 22a, 25 May 77

SMR reach 22b, 27 May 80

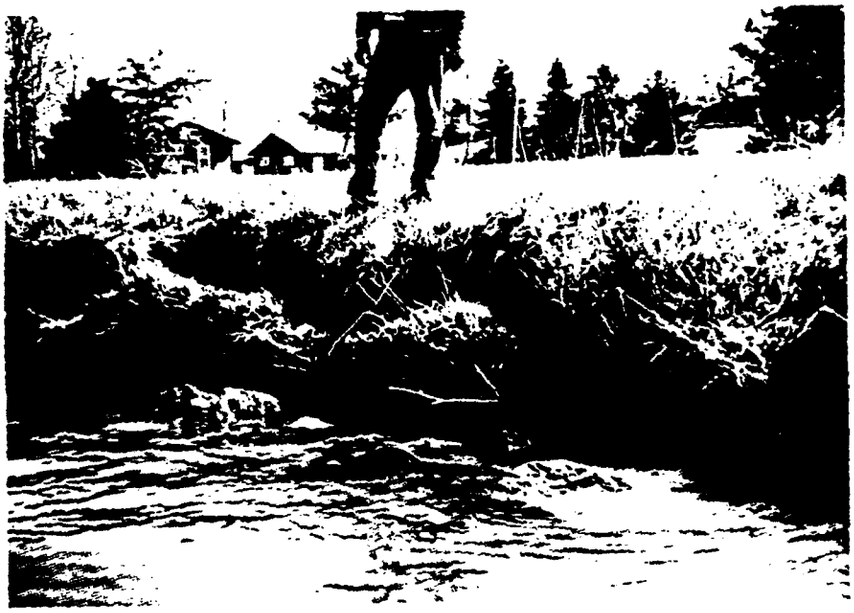
SMR reach 24b, 2 Nov 78

SMR reach 24b, 2 Nov 78

SMR site 25, 25 May 77

SMR reach 27a, 5 Oct 79

SMR reach 27b, 18 May 79



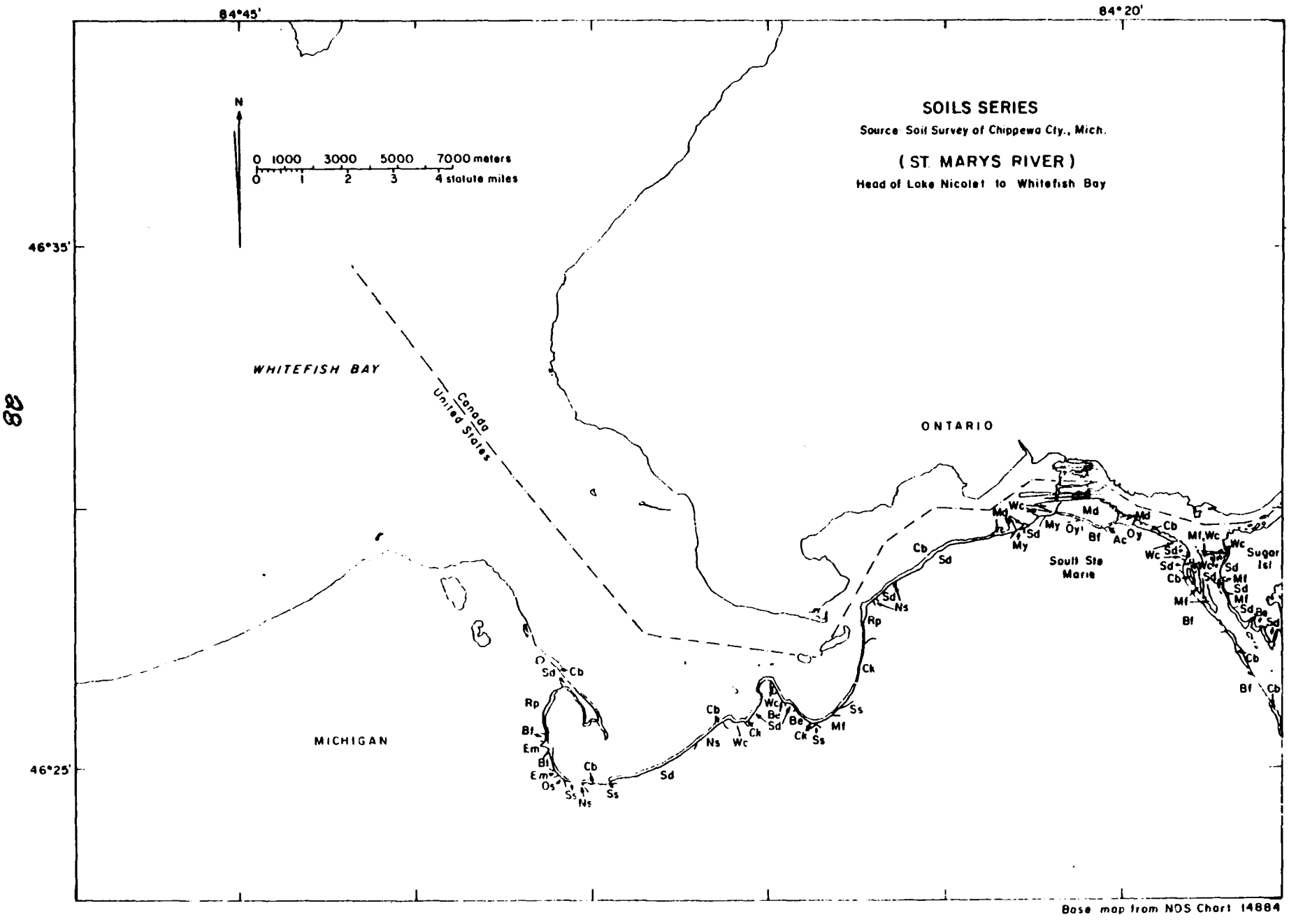
SMR reach 27b, 18 May 79

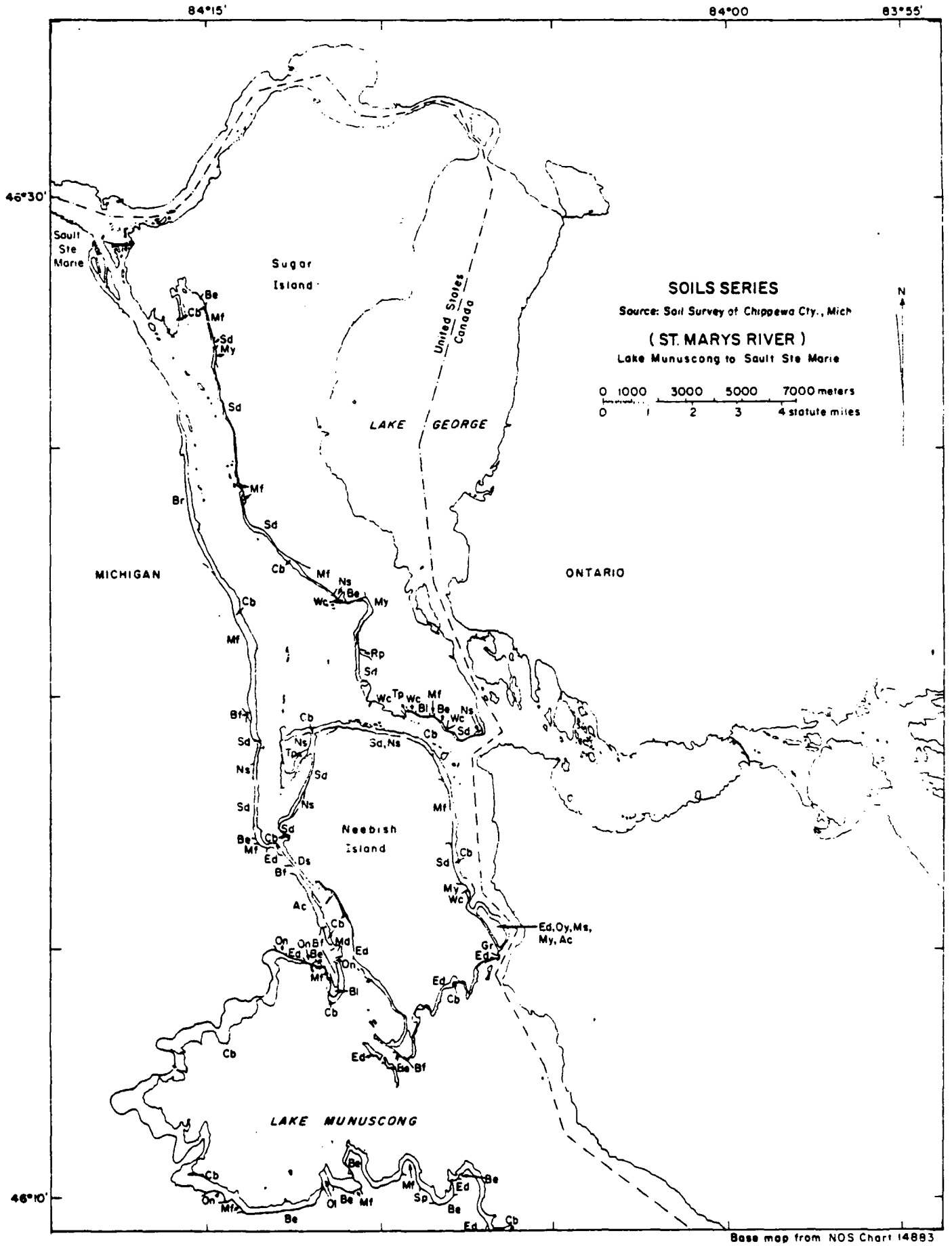
St. Marys River

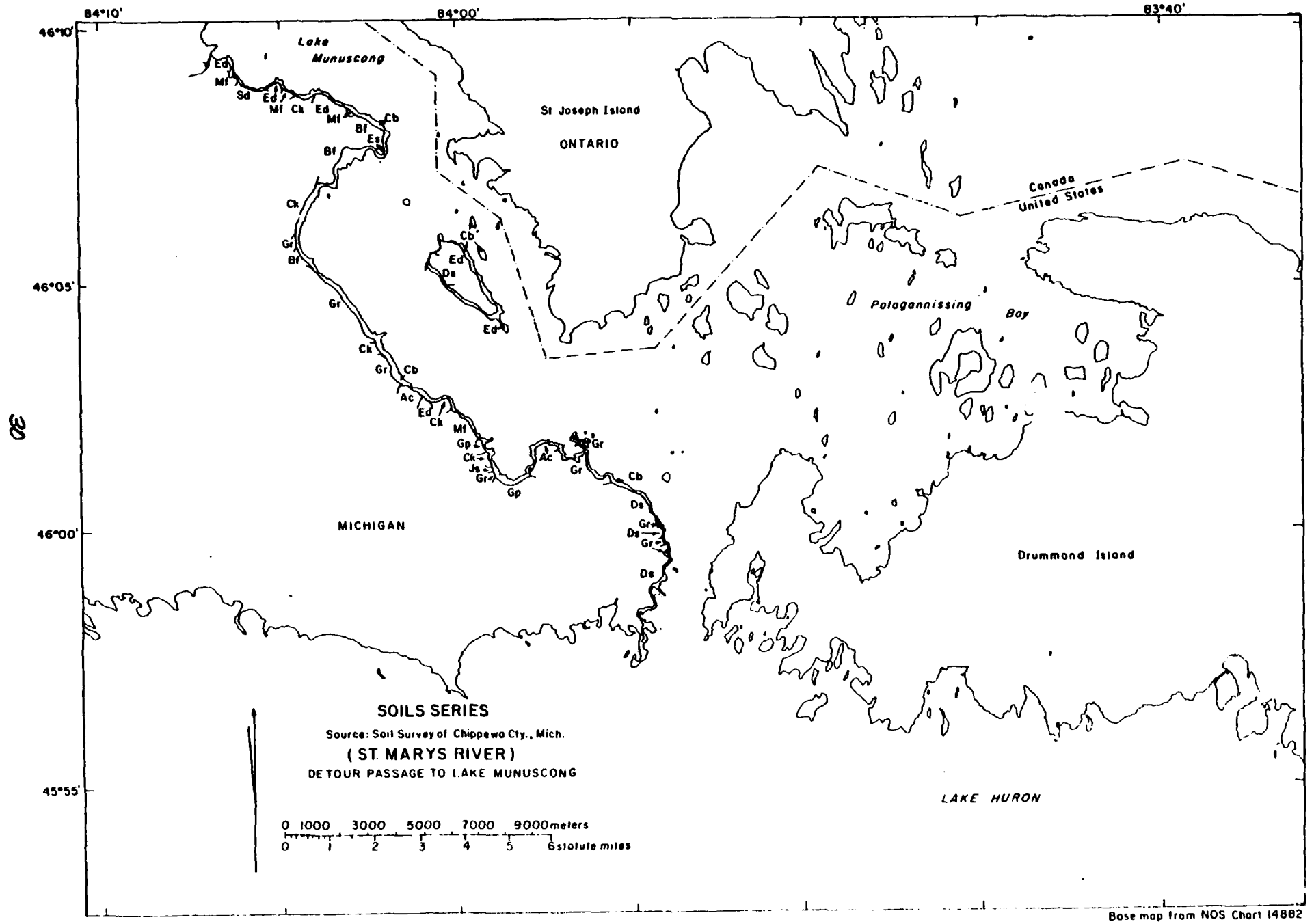
Bank soils from SCS soil surveys.

Soils Legend - St. Marys River (Chippewa County)

Ac	Alpena cobbly loam
Be	Bergland silty clay loam
Bf	Bruce fine sandy load
Bl	Bruce silt loam
Cb	Coastal Beach
Ck	Carbondale muck
Ds	Detour stony loam, shallow phase
Ed	Eastport sand
Em	Ewen silt loam, alluvial fan phase
Es	Emmet stony loamy sand
Gp	Greenwood peat
Gr	Granby sand
Js	Johnswood stony loam
Md	Made land
Mf	Munuscong fine sandy loam
My	Munising stony sand loam
Ns	Newton sand
Ol	Ontonagon silt loam
On	Onaway stony loam
Os	Ogemaw sandy loam
Oy	Ontonagon silty clay loam, slope phase
Rp	Rifle peat
Sd	Shelldrake sand
Sp	Spalding peat
Ss	Saugatuck sand
Wc	Waiska cobbly sandy loam


84°45'
84°20'
46°35'
46°25'
N
0 1000 3000 5000 7000 meters
0 1 2 3 4 statute miles
SOILS SERIES
Source: Soil Survey of Chippewa Cty., Mich.
(ST. MARYS RIVER)
Head of Lake Nicolet to Whitefish Bay
WHITEFISH BAY
Canada
United States
ONTARIO
MICHIGAN
Soult Ste Marie
Sugar Isl
Base map from NOS Chart 14884


84°15'
84°00
83°55'
46°30'
46°10'
Sault Ste Marie
Sugar Island
United States
Canada
LAKE GEORGE
MICHIGAN
ONTARIO
Neebish Island
LAKE MUNUSCONG
SOILS SERIES
Source: Soil Survey of Chippewa Cty., Mich
(ST. MARYS RIVER)
Lake Munuscong to Sault Ste Marie
0 1000 3000 5000 7000 meters
0 1 2 3 4 statute miles
N
Ed,Oy,Ms, My, Ac
Base map from NOS Chart 14883


84°10'
84°00'
83°40'
46°10'
46°05'
46°00'
45°55'
Lake Munuscong
St Joseph Island
ONTARIO
Canada
United States
Potagannissing Bay
MICHIGAN
Drummond Island
LAKE HURON
SOILS SERIES
Source: Soil Survey of Chippewa Cty., Mich.
(ST. MARYS RIVER)
DETOUR PASSAGE TO LAKE MUNUSCONG
0 1000 3000 5000 7000 9000 meters
0 1 2 3 4 5 6 statute miles
Base map from NOS Chart 14882

St. Marys River

Descriptions, photographs and generalized river cross-sections for profiled reaches, some eroding reaches and selected sites (distances in feet).

SITE NO. SNR 1

Sample taken ☐ Yes ☐ No

BEACH Photo No.____	☐ Yes ☐ No	Orientation NW-SE	Width 10-20	Texture Gravelly sand	Remarks				
BLUFF Photo No.____	Orientation NW-SE	Height 5-20	Slope 45-60°	Length 4000	Evidence of Surface Runoff ☐ No Rills Gullies	Evidence of Groundwater Seepage ☐ No Staining Damp Zone Vegetation Other	Remarks Talus at toe; lower on NW end (Fig. D1)		
	Vegetation Collapsing Stable Type X (Fig. D3) Grass/trees	Remarks Vegetation mat on top of bluff frequently overhangs (Fig. D1 and D2)							
SOIL	☐ Artificial (fill) ☐ Natural	*Texture* Sandy	*Color* Light tan	*Structures* Stratified (Fig. D2)	*Remarks* Layers of gravel and cobbles; till in bluff on southern end				
NEARSHORE CONDITIONS	Bathymetry Shelf Steep Shelf/Drop off X (Fig. D 3 and D13)	Texture Cobbles and gravel with ~~sand pockets~~	Bedforms ☐ No	Vegetation ☐ No Type Density	Remarks Shelf is armored with cobbles and pebbles				
LANDUSE	Residential Sparse ☐ Medium ☐ Dense ☐	Commercial Sparse ☐ Medium ☐ Dense ☐	Agricultural	Recreational	None	Remarks Homes very scattered			
UPSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Gab Other None	Vegetated Bluff X	Slope Becomes gradual	Nearshore Conditions Similar	Remarks Bluff height decreases				
DOWNSTREAM CONDITIONS Photo No.____	Protective Structures B.H. RR Gab Other None	Vegetated Bluff X	Slope Becomes gradual	Nearshore Conditions Similar	Remarks Bluff height decreases				

REMARKS

Site descriptions, photographs and cross-sections for site 1 are included since these bluffs would probably erode very quickly if the water level was high enough to be at the toe.

SITE NO. SMR4b DATE _____ Weather:

Sample taken ☐ Yes ☐ No

SMR 4b

BEACH Photo No. _____	☐ Yes ☐ No	Orientation N-S and E-W	Width Variable, <3	Texture Sand	Remarks Alders stablize grass and form a series of promotories and inlets (Fig. D4)

BLUFF Photo No. ____	Orientation Variable	Height 0-1.5	Slope No true bluff	Length 1000	Evidence of Surface Runoff ☒ Yes ☐ No Rills Gullies	Evidence of Groundwater Seepage ☒ No Staining Damp Zone Vegetation Other	Remarks Height of clumps

	Vegetation Collapsing Stable Type Grass/alder	Remarks Clumps of grass and alder roots are eventually eroded from backshore; no distinct bluff; waves wash over shoreline

SOIL	☐ Artificial (fill) ☒ Natural	Texture Sand	Color Tan	Structures Not observable

Remarks

NEARSHORE CONDITIONS	Bathymetry Shelf Steep Shelf/Drop off X (Fig. D14)	Texture Sand	Bedforms ☐ No Ripples	Vegetation ☒ No Type Density	Remarks Depressions near the waterline are filled with organic material eroded from shore

LANDUSE	Residential Sparse ☐ Medium ☐ Dense ☐	Commercial Sparse ☐ Medium ☐ Dense ☐	Agricultural	Recreational	None X	Remarks Undeveloped, low-lying plain

UPSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Gab Other	Vegetated Bluff	Slope Gentle	Nearshore Conditions Similar (Fig. D5)	Remarks Same type of shoreline along Izaak Walton Bay with offshore islands (formed from dredge material)
DOWNSTREAM CONDITIONS Photo No. _____	Protective Structures B.H. RR Gab Other	Vegetated Bluff	Slope Gentle	Nearshore Conditions Similar	Remarks Bluff heights vary from <1 to 20 ft; dense residental development

REMARKS Twelve additional reaches occur along Site 4. They are small and separated by protected or stable banks. Offshore slope is gentle; with scattered areas of offshore vegetation along this reach. Grasses along Sherman Park may be actively eroding.

SITE NO. SMR5a DATE _____ Weather:

Sample taken ☒ Yes ☐ No

SMR 5a

BEACH Photo No. ____	☒ Yes ☐ No	Orientation: NNW-SSE	Width: 0-5	Texture: Gravel with cobbles	Remarks: Branches and trees scattered over the beach	
BLUFF Photo No. ____	Orientation: NNW-SSE	Height: 2-5	Slope: 45°-90°	Length: 1000	Evidence of Surface Runoff: Rills, Gullies ☒ No	Evidence of Groundwater Seepage: Staining, Damp Zone, Vegetation, Other ☒ No
	Vegetation: Collapsing X; Stable; Type: Brush, trees, grasses	Remarks: Many roots are exposed along the bluff (Fig. D6)				
SOIL	☐ Artificial (fill) ☒ Natural	Texture: Clayey sand with gravel and cobbles	Color: Grey	Structures: None	Remarks: Clay under sandy upper zone	
NEARSHORE CONDITIONS	Bathymetry: Shelf; Steep; Shelf/Drop off: X (Fig. D15)	Texture: Sandy	Bedforms ☐ No: Not observable	Vegetation ☒ No: Type; Density	Remarks	
LANDUSE	Residential: Sparse ☐ Medium ☐ Dense ☐	Commercial: Sparse ☐ Medium ☐ Dense ☐	Agricultural	Recreational	None: X	Remarks: No development on island
UPSTREAM CONDITIONS Photo No.	Protective Structures: B.H.; RR: X; Gab; Other	Vegetated Bluff	Slope: Vegetated	Nearshore Conditions: Similar	Remarks: Riprap along upstream island to protect park shore and Coast Guard light	
DOWNSTREAM CONDITIONS Photo No. ____	Protective Structures: B.H.; RR; Gab; Other	Vegetated Bluff	Slope: Vegetated	Nearshore Conditions: Similar	Remarks	

REMARKS Rest of Reach 5a on Island 1 has a grassy bluff with scattered small slide surfaces

SITE NO SMR 6d DATE _____ Weather:

Sample taken ☐ Yes ☐ No

SMR 6d

BEACH Photo No. ____	☐ Yes ☒ No	Orientation	Width	Texture	Remarks Water at base of grasses (Fig. D8)

BLUFF Photo No. ____	Orientation NW-SE	Height 1-2	Slope No true bluff (Fig. D7)	Length 300	Evidence of Surface Runoff ☐ No Rills Gullies	Evidence of Groundwater Seepage ☐ No Staining Damp Zone Vegetation Other	Remarks

	Vegetation Collapsing Stable Type Grass	Remarks Water undercutting grass which eventually falls off as clumps

SOIL	☐ Artificial (fill) ☒ Natural	Texture Sandy	Color Tan	Structures Not observable	Remarks

NEARSHORE CONDITIONS	Bathymetry Shelf Steep Shelf/Drop off X (Fig. D15)	Texture Very fine sand	Bedforms ☐ No Ripples	Vegetation ☐ No Type Density	Remarks Grass clumps lay along bottom nearshore

LANDUSE	Residential Sparse ☐ Medium ☐ Dense ☐ X	Commercial Sparse ☐ Medium ☐ Dense ☐	Agricultural	Recreational	None	Remarks

UPSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Gab Other X	Vegetated Bluff	Slope Gentle	Nearshore Conditions Similar	Remarks
DOWNSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Gab Other X	Vegetated Bluff Partially	Slope	Nearshore Conditions Similar	Remarks Higher bluff, 1 to 7 ft, with trees; being protected with ripr

REMARKS Remainder of Site 6 has five scattered reaches of active erosion separated by protected banks, i.e. riprap, tree slash, concrete slabs. Trees are collapsed at some reaches.

SITE NO. SMR 11b DATE _____ Weather:

Sample taken ☐ Yes ☐ No

SMR 11b

BEACH Photo No.____	☒ Yes ☐ No	Orientation N-S	Width 5-15	Texture Fine sand	Remarks No beach when water level is up as in May 1979 (Fig. D9)				
BLUFF Photo No.____	Orientation N-S	Height .5-1.5	Slope >60°	Length 400	Evidence of Surface Runoff ☒ No Rills Gullies	Evidence of Groundwater Seepage ☒ No Staining Damp Zone Vegetation Other	Remarks No distinct bluff		
	Vegetation Collapsing X Stable Type Grass and brush	Remarks Grass on bluff face; soil eroded from under grass mat which eventually collapses; bankline is a series promontories and embayments (Fig. D9)							
SOIL	☐ Artificial (fill) XX ☐ Natural	Texture Fine sand	Color Tan	Structures Not observed	Remarks Grassless bluff occurs where clump has fallen off				
NEARSHORE CONDITIONS	Bathymetry Shelf X Steep (Fig. D16) Shelf/Drop off	Texture Fine sand with scattered rock	Bedforms ☐ No Ripples	Vegetation ☒ No Type Density	Remarks Grass clumps offshore near waterline. Bottom gets soft farther offshore.				
LANDUSE	Residential Sparse ☐ Medium ☐ Dense ☐	Commercial Sparse ☐ Medium ☐ Dense ☐	Agricultural	Recreational X	None	Remarks Dunbar Park; grass field behind small bluff			
UPSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Gab Other	Vegetated Bluff	Slope Very gentle	Nearshore Conditions Similar	Remarks Grassy, gentle plain; no bluff				
DOWNSTREAM CONDITIONS Photo No.____	Protective Structures B.H. RR Gab Other	Vegetated Bluff	Slope Very gentle	Nearshore Conditions Similar	Remarks Bends into Charlotte River				

REMARKS

SITE NO. SMR 23b DATE _____ Weather:

Sample taken ☐ Yes ☐ No

SMR 23b

BEACH Photo No.____	☒ Yes ☐ No	Orientation NNE-SSW	Width 3-7	Texture Gravel to boulders	Remarks Fig. D10

BLUFF Photo No.____	Orientation NNE-SSW	Height .5-7	Slope 30°-60°	Length 600	Evidence of Surface Runoff ☐ No Rills Gullies	Evidence of Groundwater Seepage ☐ No Staining Damp Zone Vegetation Other	Remarks

	Vegetation Collapsing Stable Type	Remarks
	X Grasses	Grass covers bank on northern portion (Fig. D11)

SOIL	☐ Artificial (fill) ☒ Natural	Texture Sand with cobbles and boulders	Color Grey to tan	Structures None	Remarks Looks like till

NEARSHORE CONDITIONS	Bathymetry Shelf Steep Shelf/Drop off X (Fig. D16)	Texture Cobbles and boulders	Bedforms ☒ No	Vegetation ☒ No Type Density	Remarks

LANDUSE	Residential Sparse ☐ Medium ☐ Dense ☐	Commercial Sparse ☐ Medium ☐ Dense ☐	Agricultural	Recreational	None	Remarks One house

UPSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Gab Other	Vegetated Bluff	Slope Vegetated	Nearshore Conditions Similar	Remarks
DOWNSTREAM CONDITIONS Photo No.____	Protective Structures B.H. RR Gab Other	Vegetated Bluff	Slope Vegetated	Nearshore Conditions Similar	Remarks

REMARKS

SITE NO. SMR 24b DATE _____ Weather:

Sample taken ☐ Yes ☐ No

SMR 24b

BEACH Photo No. ____	☐ Yes ☐ No	Orientation E-W	Width 0-5	Texture Sand	Remarks

BLUFF Photo No. ____	Orientation E-W	Height 0-2.5	Slope Not a distinct bluff	Length 300	Evidence of Surface Runoff ☐ No Rills Gullies	Evidence of Groundwater Seepage ☐ No Staining Damp Zone Vegetation Other	Remarks

	Vegetation Collapsing Stable Type X Grasses and trees	Remarks Bank is grass mat that has slumped down after soil has eroded from underneath

SOIL	☐ Artificial (fill) ☐ Natural	Texture Sandy	Color Tan	Structures Not observable	Remarks

NEARSHORE CONDITIONS	Bathymetry Shelf Steep Shelf/Drop off X	Texture Clayey silt	Bedforms ☐ No Ripples	Vegetation ☐ No Type Density	Remarks	

LANDUSE	Residential Sparse ☐ Medium ☐ Dense ☐ X	Commercial Sparse ☐ Medium ☐ Dense ☐	Agricultural	Recreational	None	Remarks

UPSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Gab Other	Vegetated Bluff	Slope Vegetated	Nearshore Conditions Similar	Remarks
DOWNSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Gab Other	Vegetated Bluff	Slope Vegetated	Nearshore Conditions Similar	Remarks

REMARKS SMR 24a (Little Neebish Store) was an old Corps profile site. It did not erode between May 1977 and October 1975. I did not prepare a detailed site description since there is no evidence for erosion (Fig. D12).

SITE NO. SMR 27a DATE _____ Weather:

Sample taken ☒ Yes ☐ No

SMR 27a

BEACH Photo No.____	☒ Yes ☐ No	Orientation N-S	Width 0-15	Texture Sand	Remarks			
BLUFF Photo No.____	Orientation N-S	Height .5-4	Slope 90°	Length 400	Evidence of Surface Runoff ☒ No Rills Gullies	Evidence of Groundwater Seepage ☒ No Staining Damp Zone Vegetation Other	Remarks	
	Vegetation Collapsing Stable Type x Grass	Remarks Trees, brush and grass on top of bank in northern portion; scattered slides along southern portion						
SOIL	☐ Artificial (fill) ☒ Natural	Texture Clayey sand with gravel near top	Color Tan	Structures None	Remarks			
NEARSHORE CONDITIONS	Bathymetry Shelf Steep Shelf/Drop off X (Fig. D15)	Texture Fine sand on clay	Bedforms ☐ No Ripples	Vegetation ☒ No Type Density	Remarks			
LANDUSE	Residential Sparse ☐ Medium ☐ Dense ☐ X	Commercial Sparse ☐ Medium ☐ Dense ☐	Agricultural	Recreational	None	Remarks		
UPSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Gab Other	Vegetated Bluff	Slope Vegetated	Nearshore Conditions Similar	Remarks Scattered riprap			
DOWNSTREAM CONDITIONS Photo No.____	Protective Structures B.H. RR Gab Other	Vegetated Bluff	Slope Vegetated	Nearshore Conditions Similar	Remarks Scattered riprap			

REMARKS SMR 27b is an old Corps of Engineers profile site. It was protected with boulder riprap between 1974 and 1977.

Figure D1. SMR site 1, 26 May 77.

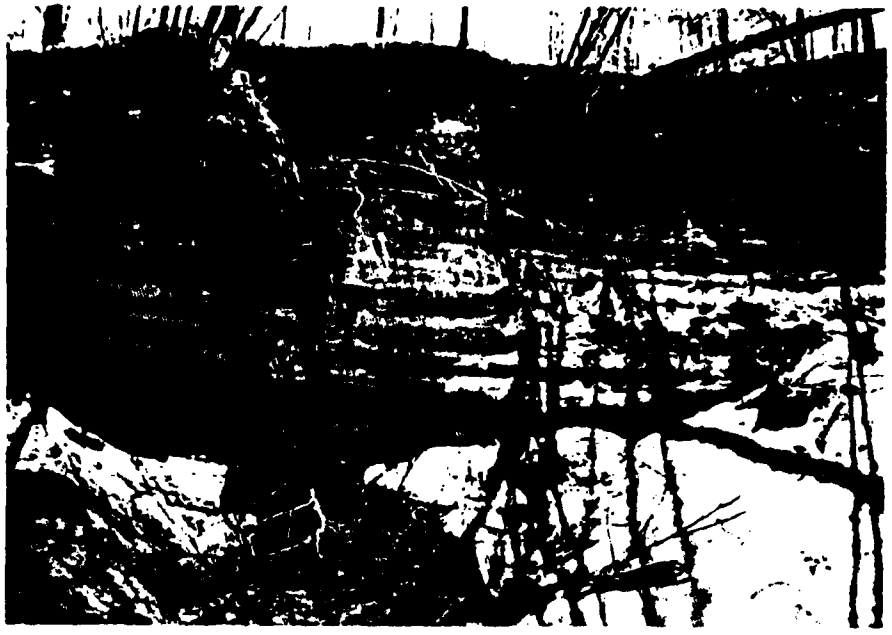


Figure D2. SMR site 1, 22 May 78.

Figure D3. SMR site 1, 22 May 78.

Figure D4. SMR reach 4b, east portion, 22 May 78.

Figure D5. SMR reach 4b, west portion, 3 Nov 78.

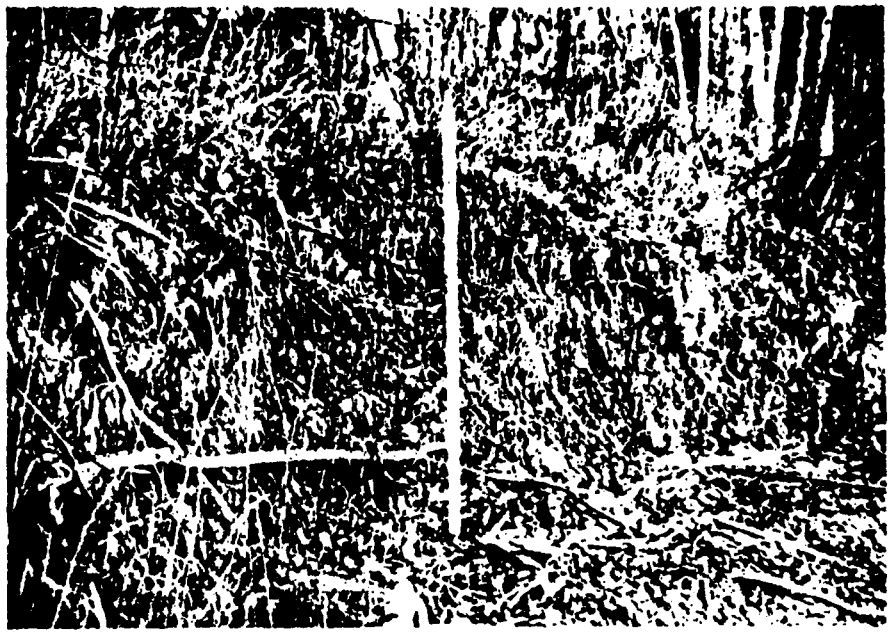


Figure D6. SMR reach 5a, 2 Nov 78.

Figure D7. SMR reach 6d, 3 Nov 78.

Figure D8. SMR reach 6d, 23 May 78.

Figure D9. SMR reach 11b, 6 Oct 79.

Figure D10. SMR reach 23b, 23 May 78.

Figure D11. SMR reach 23b, 23 May 78.

Figure D12. SMR reach 24a, 2 Nov 78.

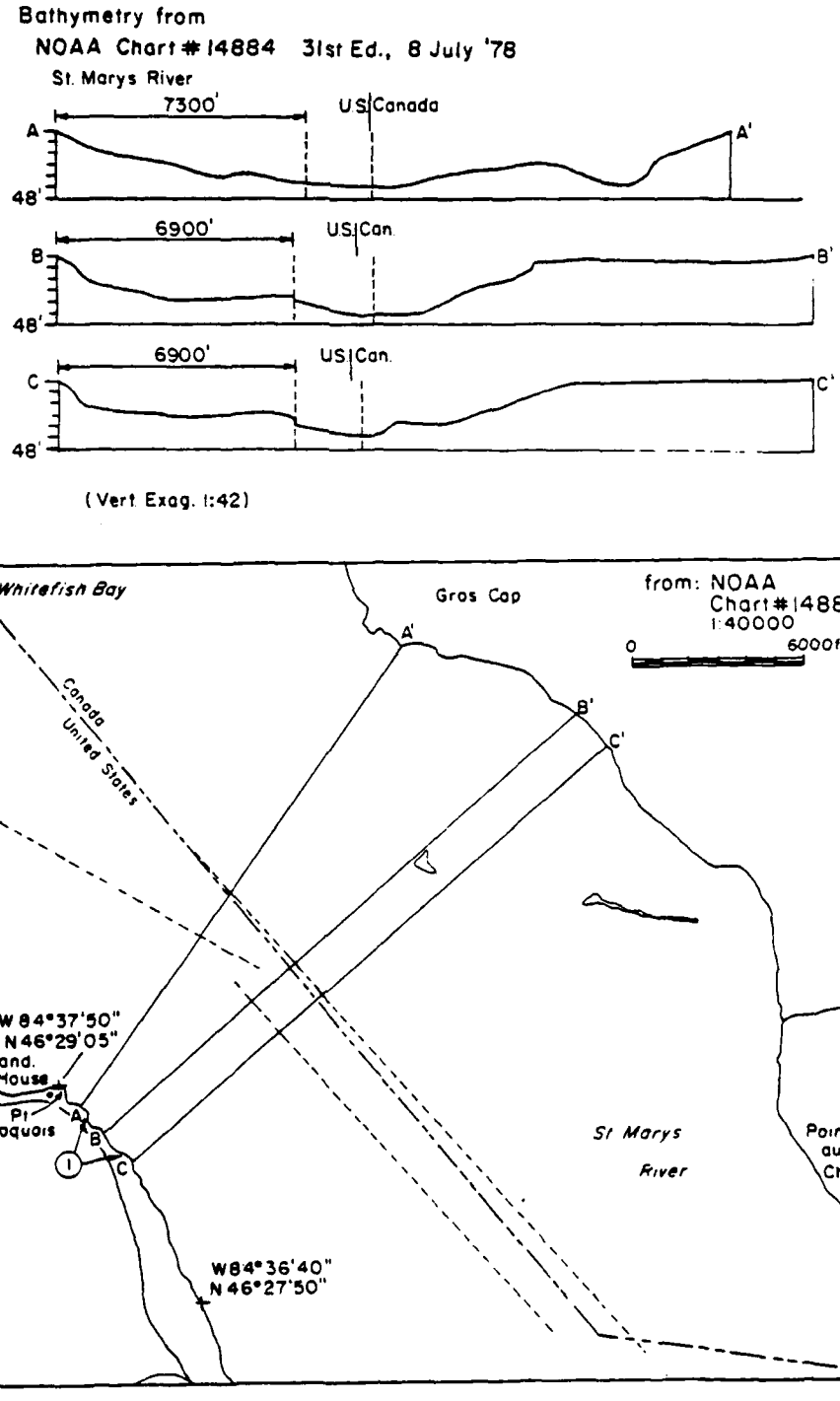
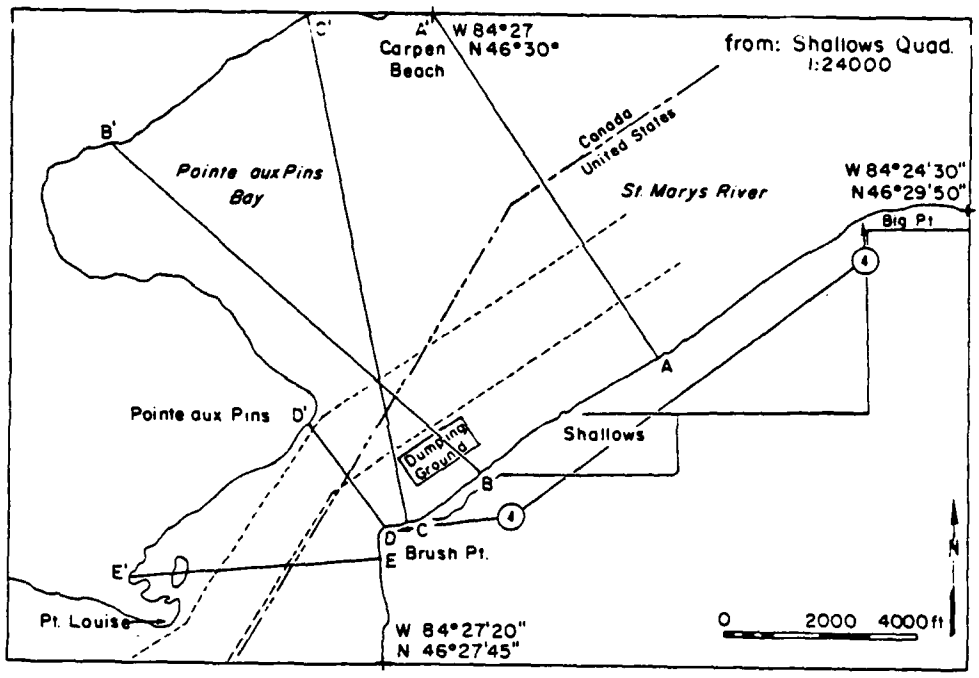
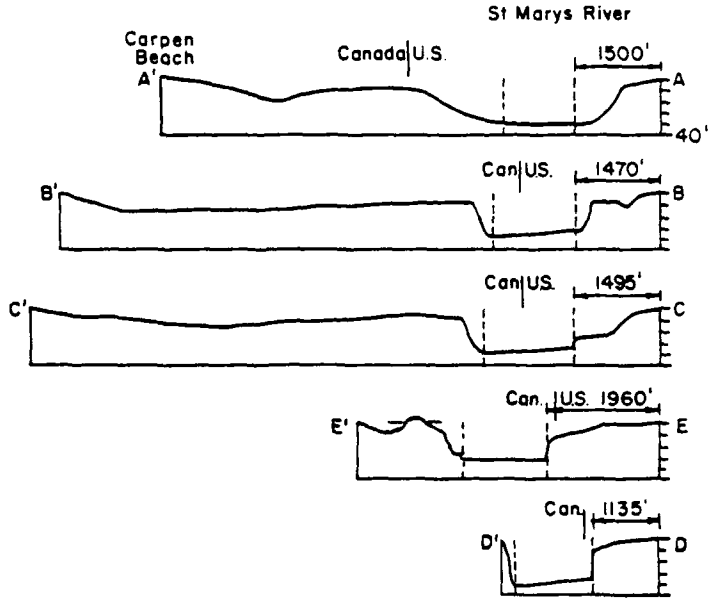


Figure D13. Generalized river cross-sections, site 1, St. Marys River.



Bathymetry from
NOAA Chart 14884
31st Ed., 8 July '78



(Vert Exag. 1:25)

Figure D14. Generalized river cross-sections, site 4, St. Marys River.

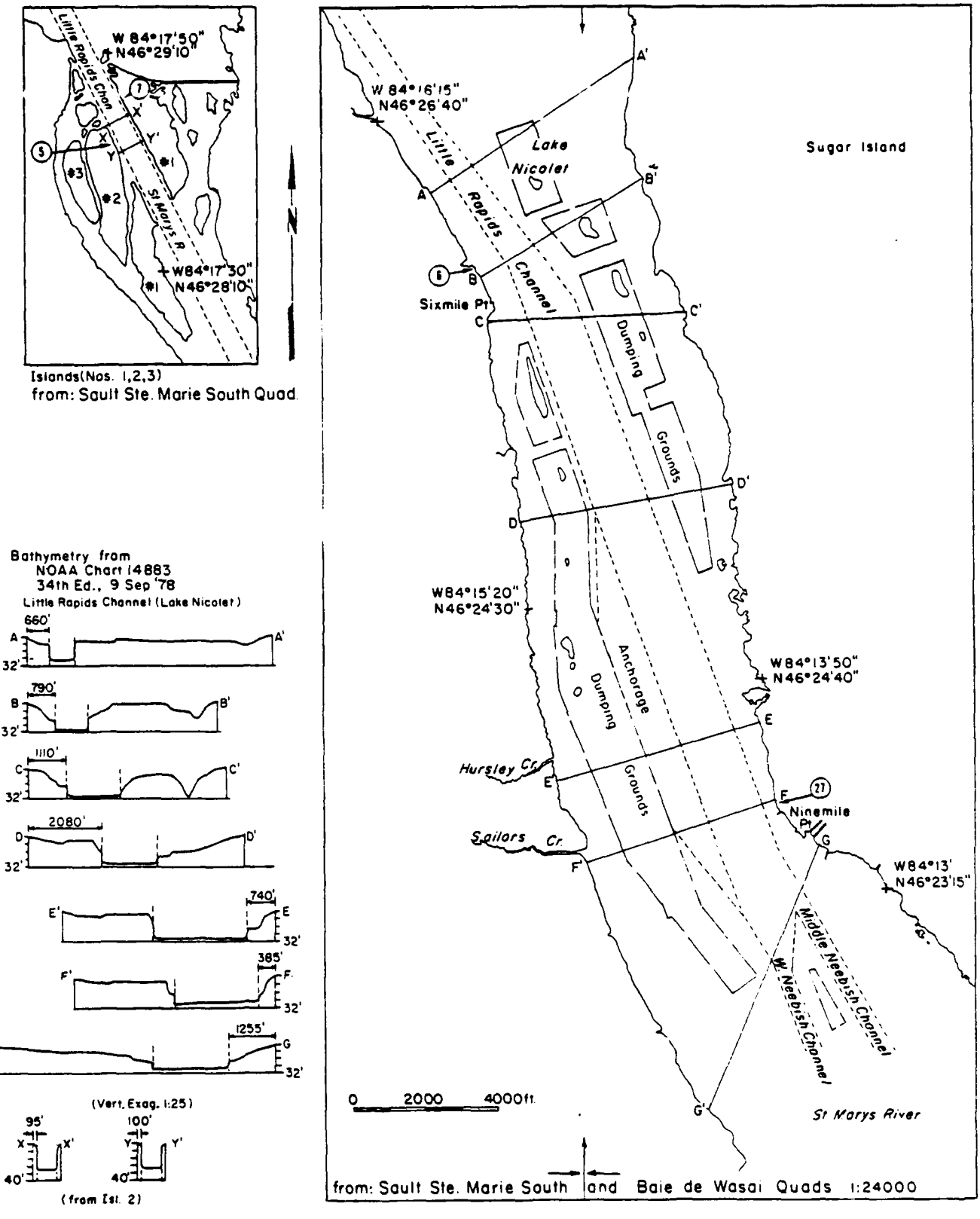
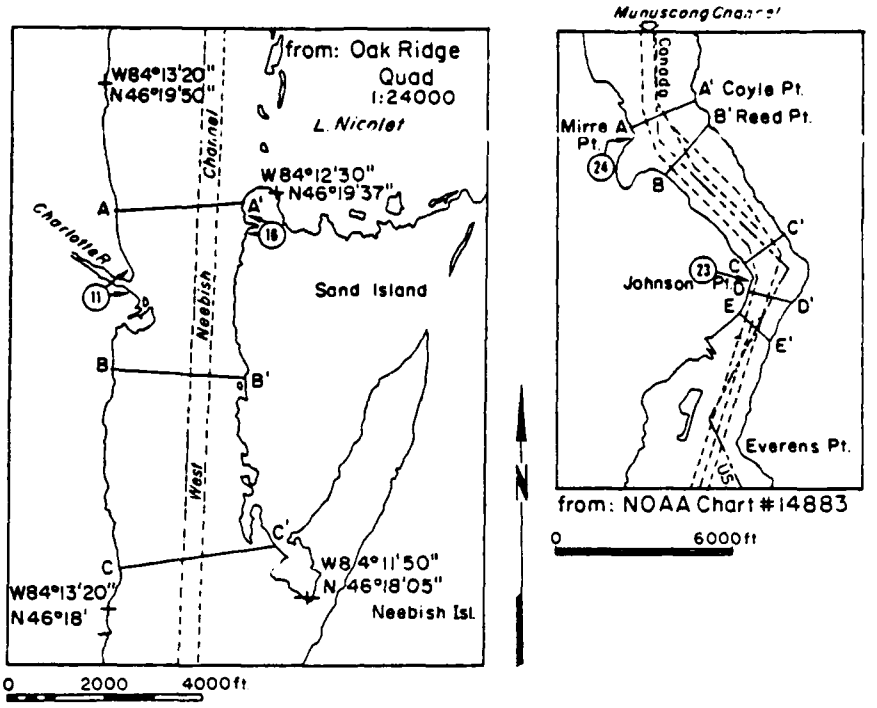
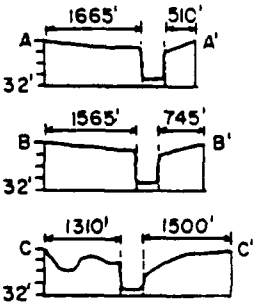


Figure D15. Generalized river cross-sections, reach 5a, site 6 and site 27, St. Marys River.



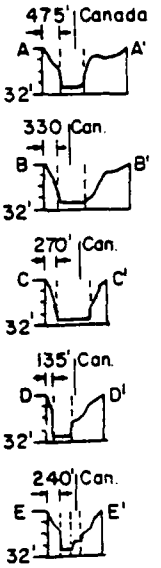
Bathymetry from NOAA Chart #14883
34th Ed., 9/9/78

(L.Nicolet - St. Marys R.)
West Neebish Channel



(Vert. Exag. 1:25)

NOAA Chart #14883
(L.Nicolet - E.Neebish Ch.)
Munuscong Channel

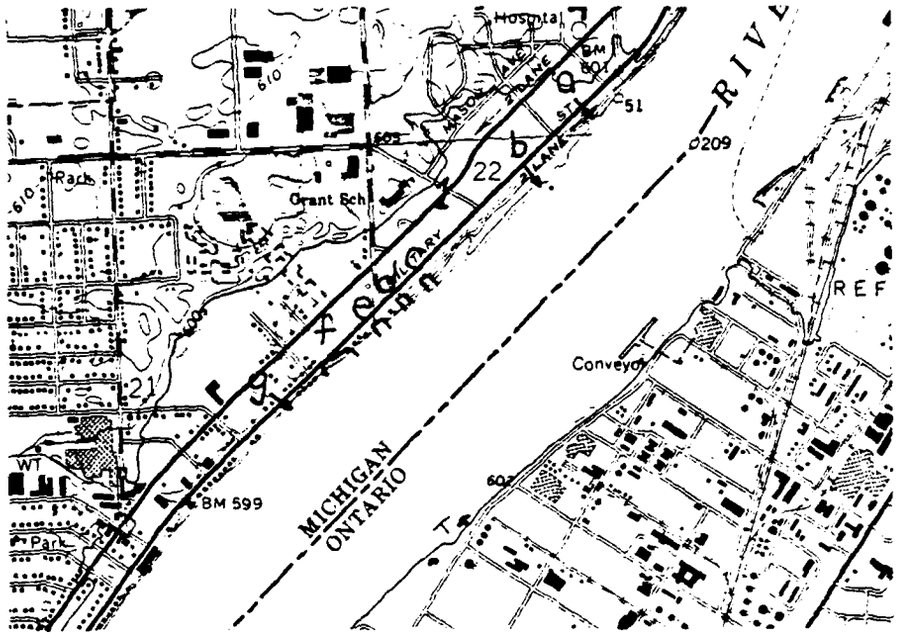


(Vert. Exag. 1:42)

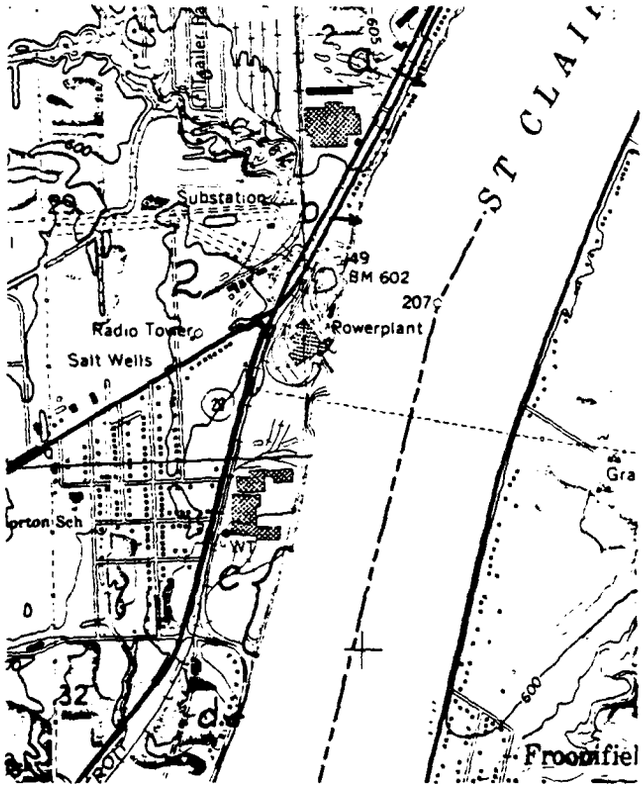
Figure D16. Generalized river cross-sections, near sites 11, 16, 23 and 24, St. Marys River.

St. Clair River

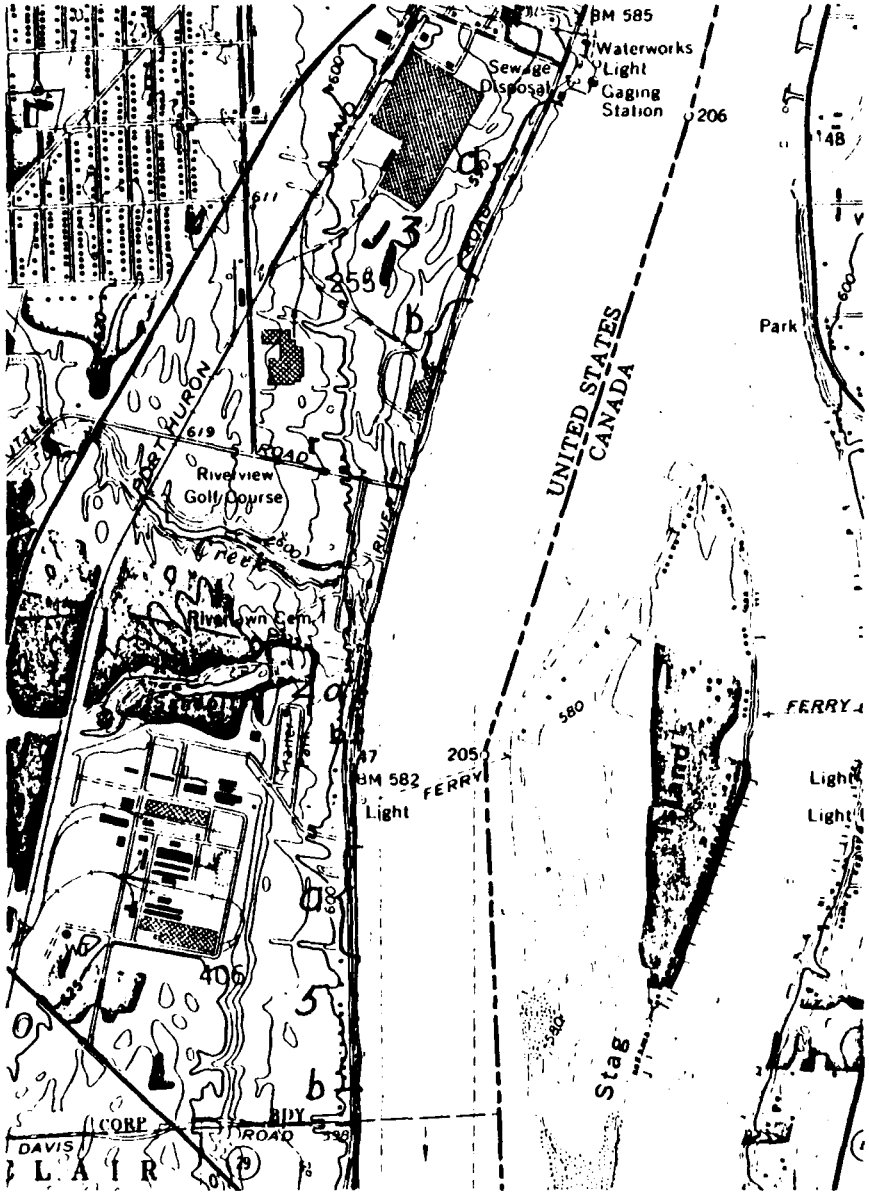
Locations of partially vegetated and bare banks (shown on portions of U.S.G.S. 7-1/2 minute-series topographic maps).



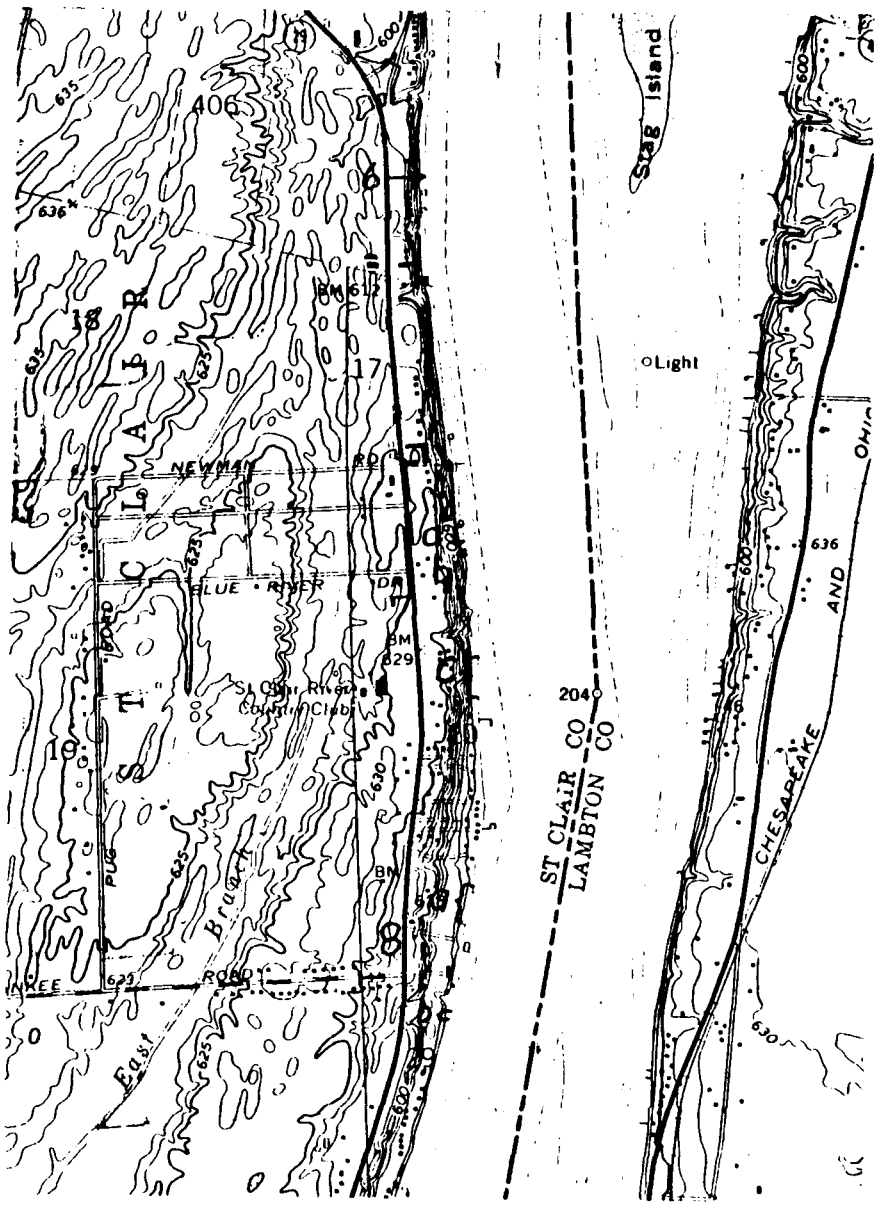
SCR site 1 (Port Huron, Mich., 1973).



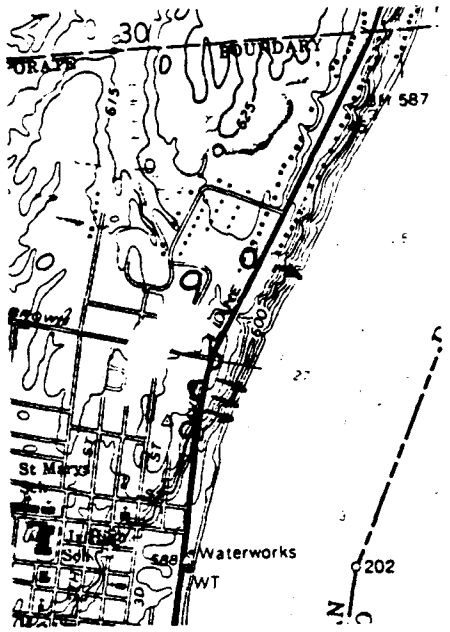
SCR site 2 (Port Huron, Mich., 1973).



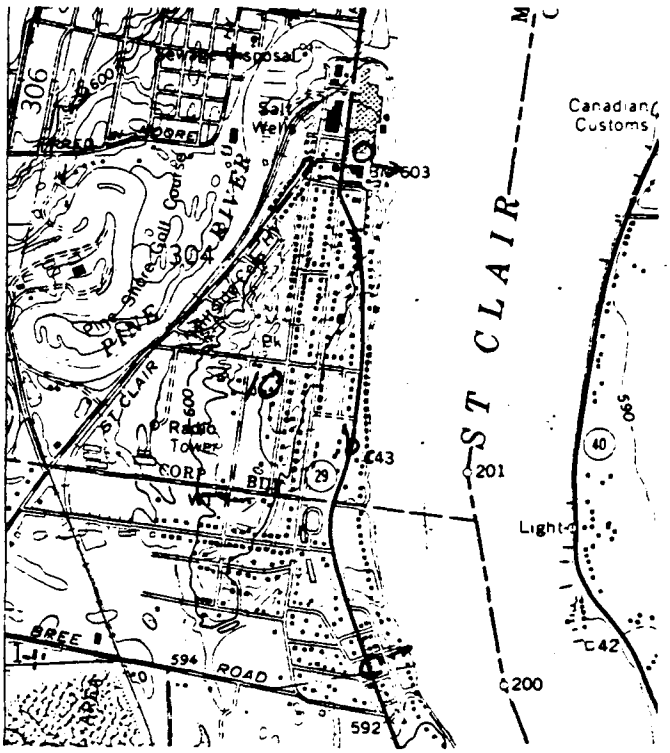
SCR sites 3, 4 and 5 (Port Huron, Mich., 1973).



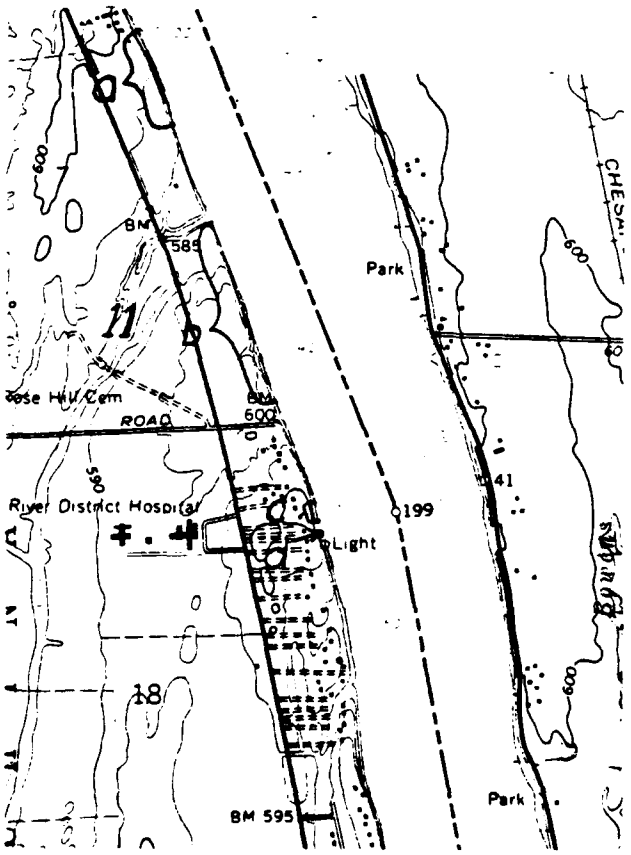
SCR sites 6, 7 and 8 (St. Clair, Mich., 1973).



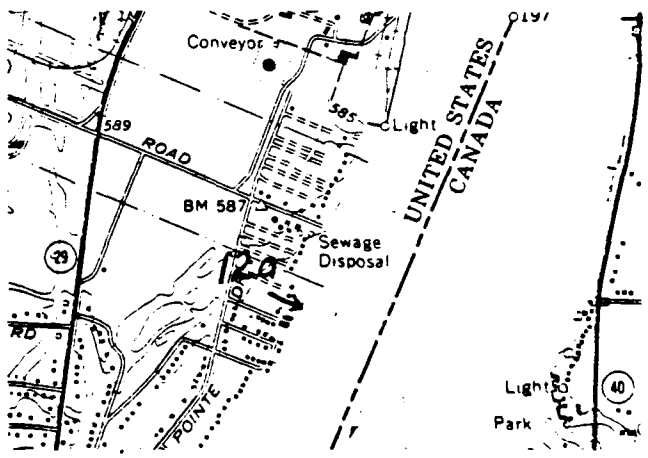
SCR site 9 (St. Clair, Mich., 1973).



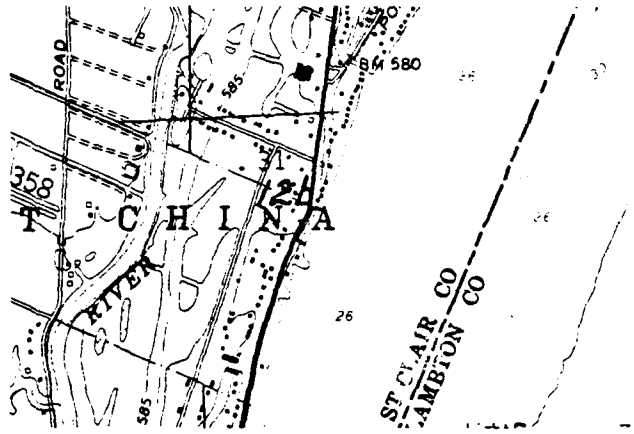
SCR site 10 (St. Clair, Mich., 1973).



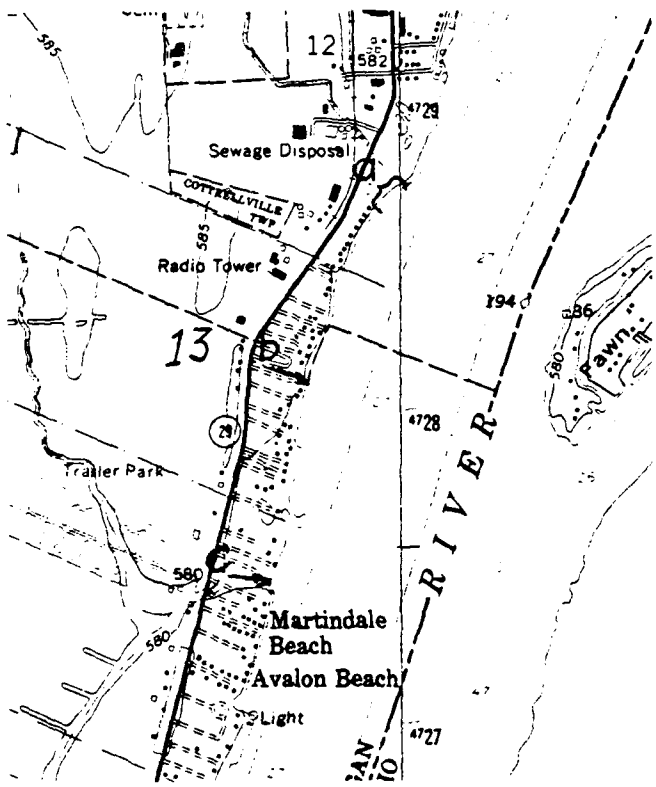
SCR site 11 (St. Clair, Mich., 1973).



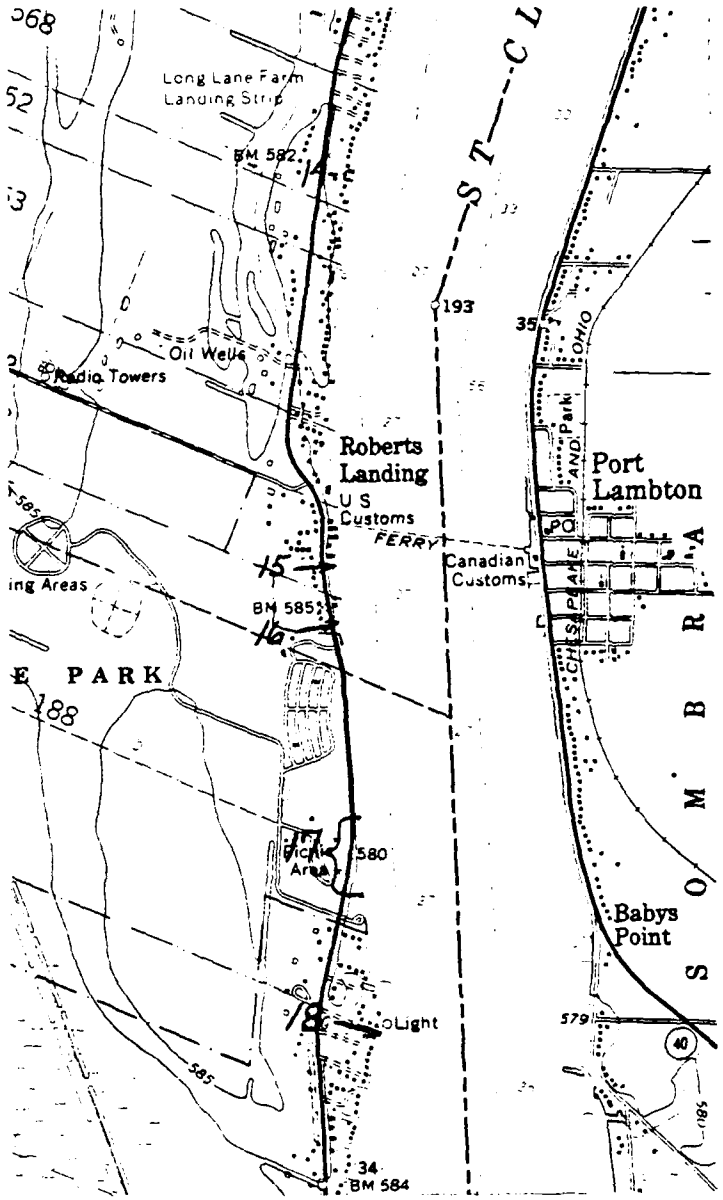
SCR site 12 (St. Clair, Mich., 1973).



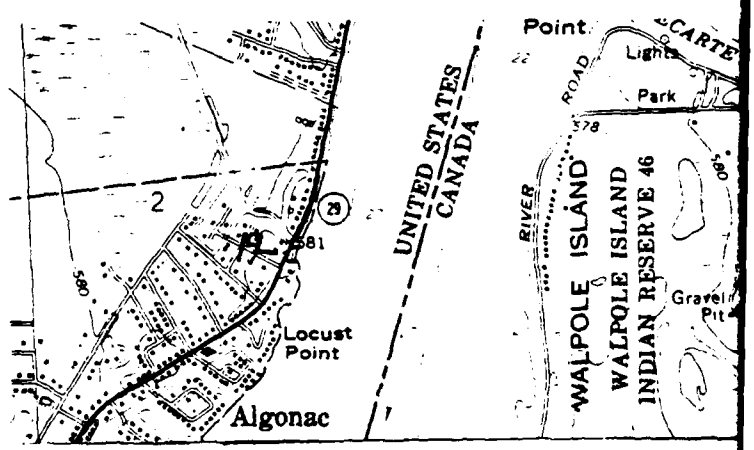
SCR site 12b(Marine city, Mich., 1973).



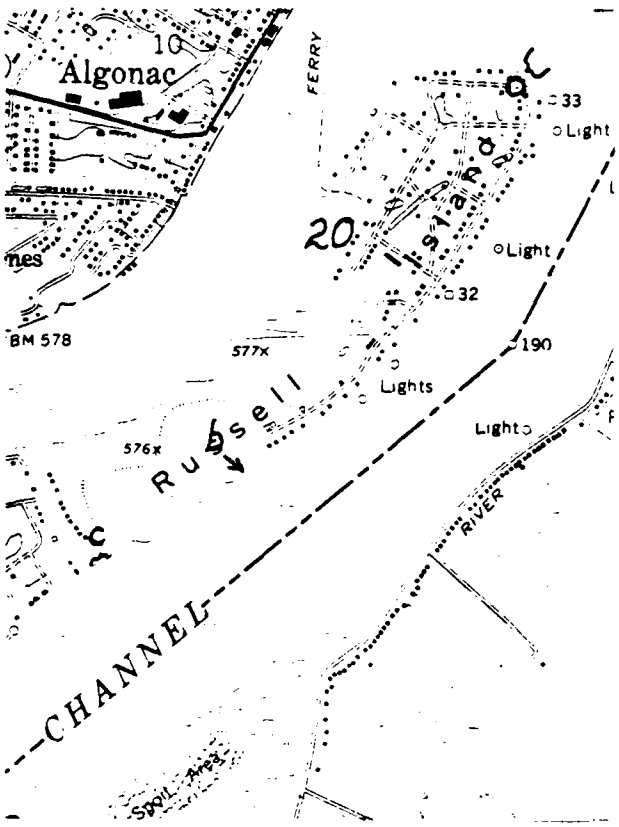
SCR site 13 (Marine City, Mich., 1973).



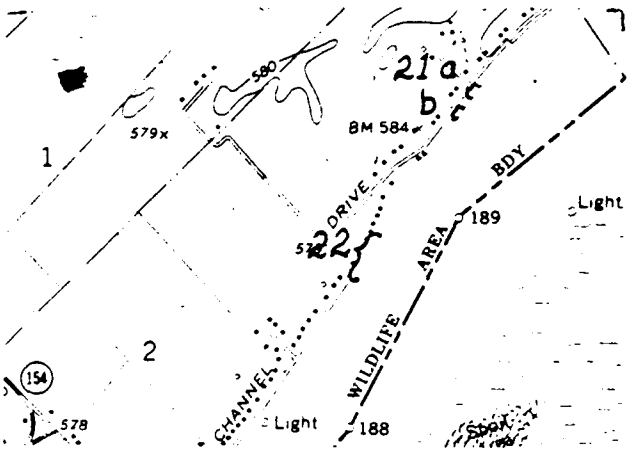
SCR sites 14, 15, 16, 17 and 18 (Marine City, Mich., 1973).



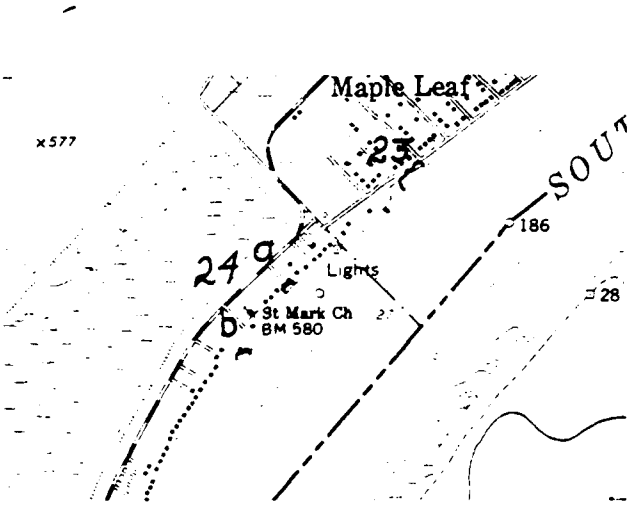
SCR site 19 (Marine City, Mich., 1973).



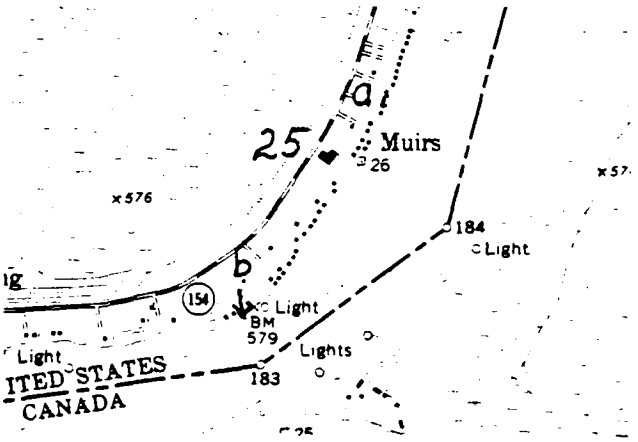
SCR site 20 (Algonac, Mich., 1973).



SCR sites 21 and 22 (Algonac, Mich., 1973).



SCR sites 23 and 24 (Algonac, Mich., 1973).



SCR site 25 (Algonac, Mich., 1973).

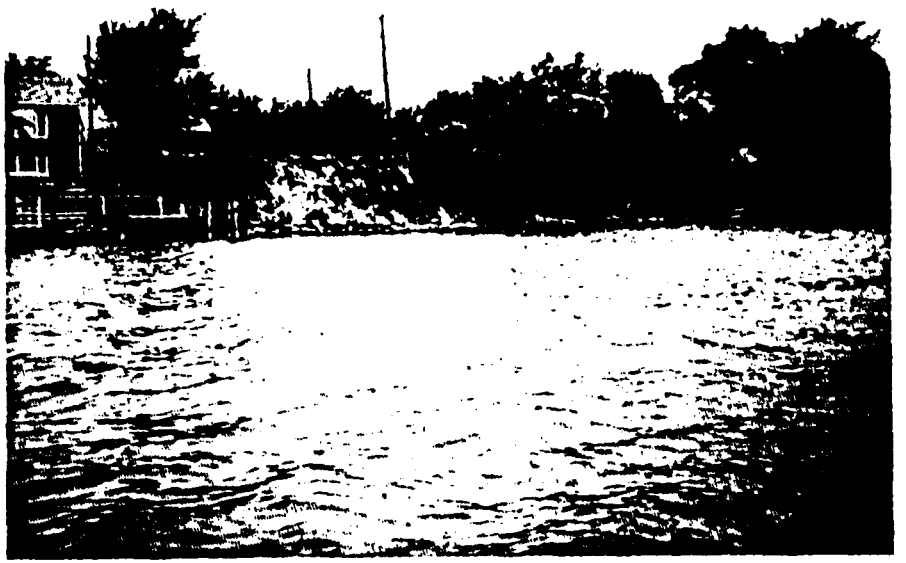
St. Clair River

Selected photographs that illustrate
the diversity of the eroding banks;
not all eroding banks are shown.

SCR reach 1e, 29 May 80

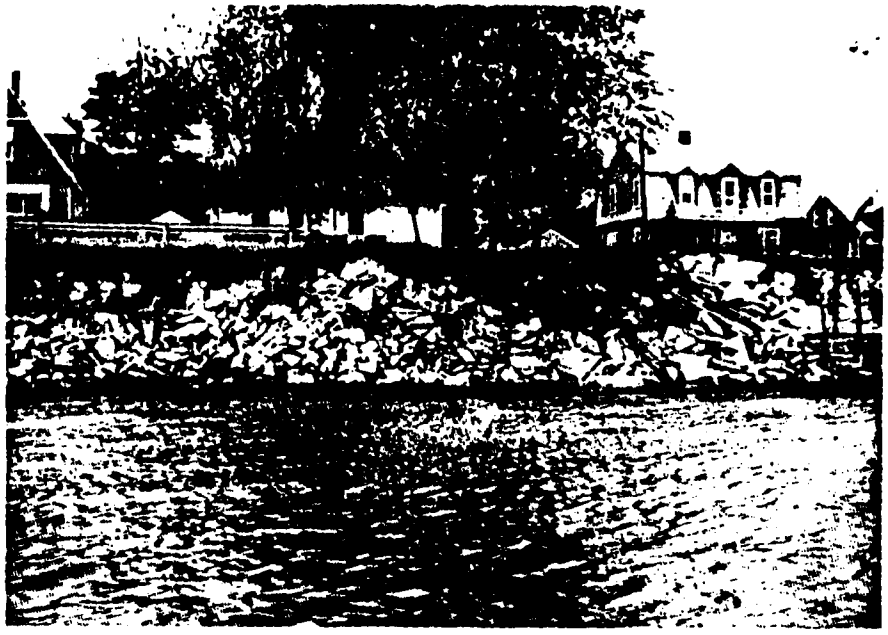
SCR reach 1f, 31 Oct 78

SCR reach 1f, 23 May 77



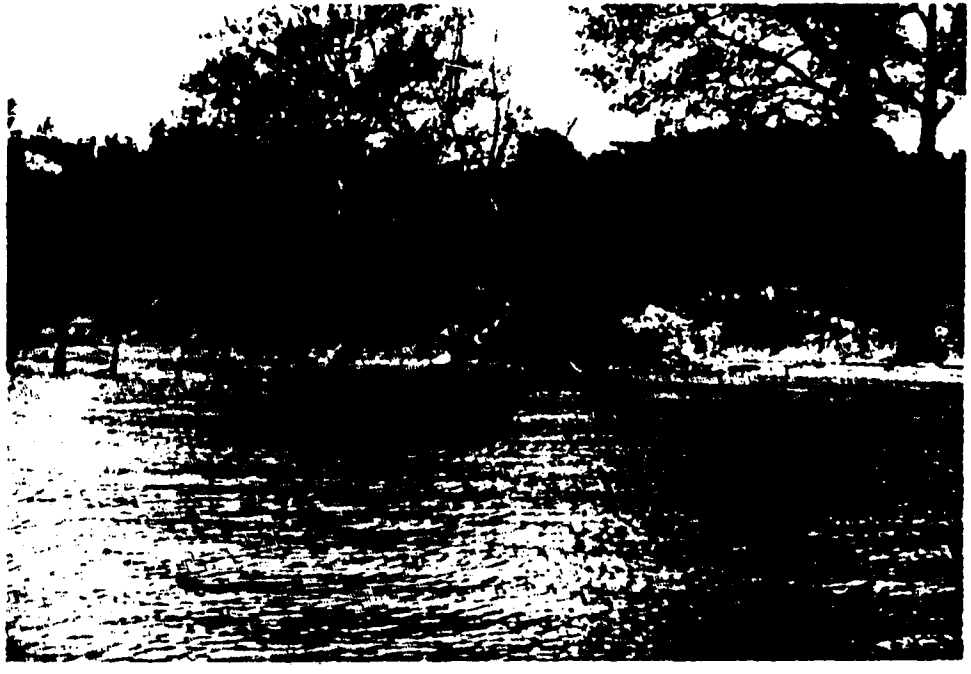
SCR reach 1g, 29 May 80

SCR reach 2b, 23 May 77



SCR reach 2d, 23 May 77

SCR reach 7a, 18 Oct 77



SCR reach 7b, 23 May 77

SCR reach 7c, 29 May 80

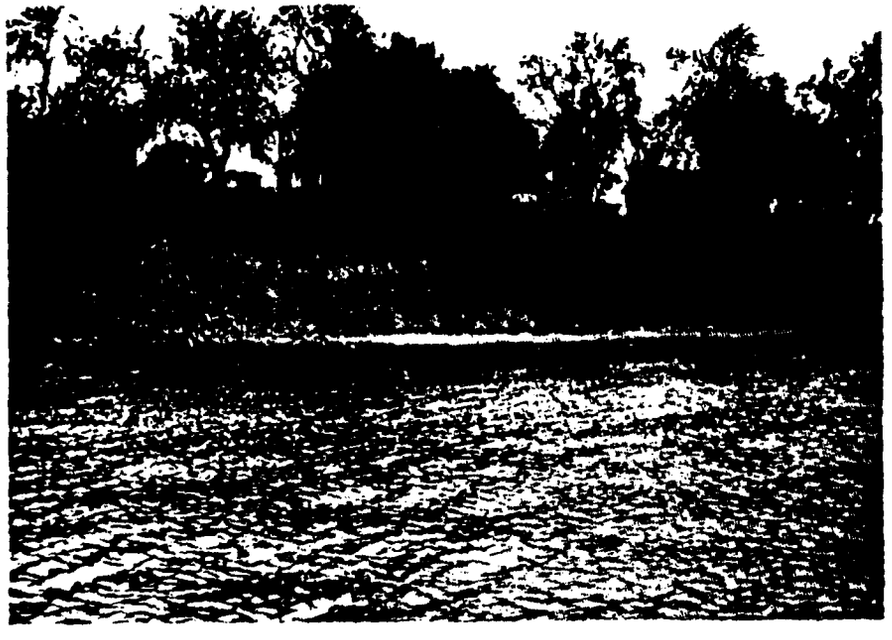
SCR reach 9a, 23 May 77

SCR reach 10b, 29 May 80

SCR reach 11a, 23 May 77

SCR reach 11b, 31 Oct 78

SCR reach 11b, 31 Oct 78



SCR reach 11c, 23 May 77

SCR reach 19, 29 May 80

SCR site 17, 19 May 79

SCR reach 20a, 22 May 78

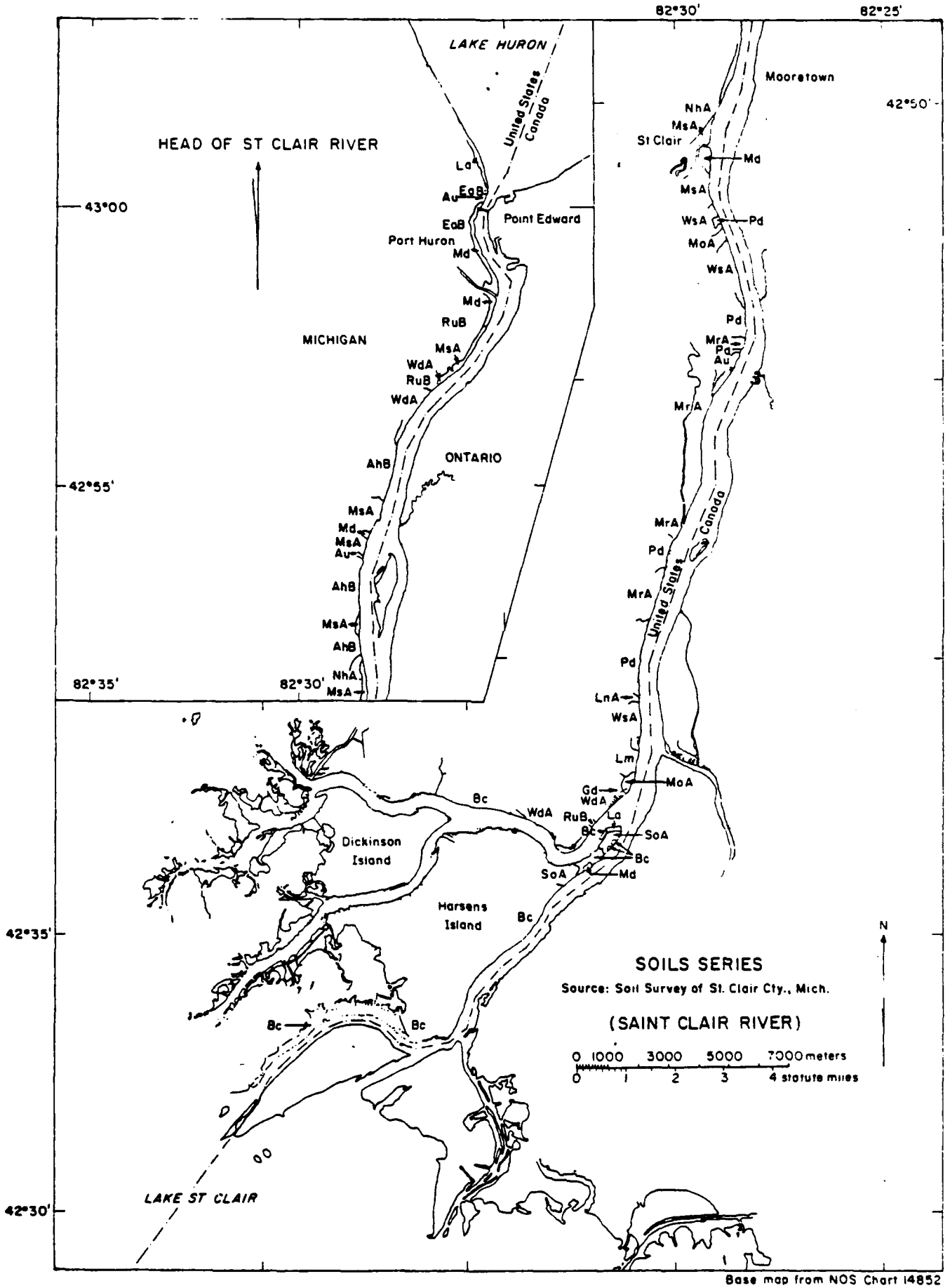
SCR reach 20a, 22 May 78

St. Clair River

Bank soils from SCS soil surveys.

Soils Legend - St. Clair River (St. Clair County)

AhB	Allendale-Hoytville complex
Au	Alluvial land
Bc	Bach very fine sandy loam
EaB	Eastport sand
La	Lake beaches
Lm	Lenawee silt loam
LnA	Lenawee complex
Md	Made land
MoA	Minoa fine sandy loam
MrA	Minoa fine sandy loam, clay substratum
MsA	Minoa-Lamson complex
NhA	Nappanee-Hoytville complex
Pd	Pauling clay
RuB	Rousseau fine sand
SaA	Sanilac very fine sandy loam
WdA	Wainola-Deford fine sands
WsA	Wasepi sandy loam, clay subsoil variant


82°30'
82°25'
LAKE HURON
United States
Canada
HEAD OF ST CLAIR RIVER
43°00
Point Edward
Port Huron
MICHIGAN
ONTARIO
42°55'
82°35'
82°30'
Mooretown
42°50'
St Clair
United States
Canada
Dickinson Island
Harsens Island
42°35'
LAKE ST CLAIR
42°30'
SOILS SERIES
Source: Soil Survey of St. Clair Cty., Mich.
(SAINT CLAIR RIVER)
0 1000 3000 5000 7000 meters
0 1 2 3 4 statute miles
N
Base map from NOS Chart 14852

St. Clair River

Descriptions, photographs and generalized river cross-sections for profiled reaches, some eroding reaches and selected sites (distances in feet).

SITE NO. SCR 3a DATE _____ Weather:

Sample taken ☐ Yes ☐ No

SCR 3a

BEACH Photo No. _____	☐ Yes ☐ No	Orientation NE-SW	Width 1-15	Texture Sand with scattered gravel and cobbles (Fig. D17)	Remarks	
BLUFF Photo No. _____	Orientation NE-SW	Height 0-2	Slope 20°-60°	Length 2000	Evidence of Surface Runoff ☒ No Rills Gullies	Evidence of Groundwater Seepage X ☒ No Staining Damp Zone Vegetation Other
	Remarks On north end, no distinct bluff (Fig.D18)					
	Vegetation Collapsing Stable Type X Grass	Remarks Isloated clumps of grasses fallen along bank, separated by vegetated bluff (Fig. D19)				
SOIL	☐ Artificial (fill) XX ☒ Natural	Texture Clayey sand	Color Tan	Structures No	Remarks	
NEARSHORE CONDITIONS	Bathymetry Shelf Steep Shelf/Drop off X (Fig. D42) X	Texture Sand	Bedforms ☐ No Ripples	Vegetation X ☒ No Type Density	Remarks Shelf is wider on north end of reach	
LANDUSE	Residential Sparse ☒ Medium ☒ Dense ☐	Commercial Sparse ☐ Medium ☐ Dense ☐	Agricultural	Recreational X	None	Remarks Park on north end
UPSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Gab Other X	Vegetated Bluff	Slope	Nearshore Conditions Similar	Remarks Bulkhead upstream of the northern end of reach	
DOWNSTREAM CONDITIONS Photo No. _____	Protective Structures B.H. RR Gab Other	Vegetated Bluff X	Slope	Nearshore Conditions Similar	Remarks	

REMARKS Site 3b separated from 3a by a vegetated bluff; road very near the top of bluff along 3b; trees and brush have collapsed at 3b (Fig. D20).

SITE NO. SCR 4b DATE _____ Weather:

Sample taken ☒ Yes ☐ No

SCR 4b

BEACH Photo No.____	☒ Yes ☐ No	Orientation N-S	Width 0-5	Texture Sand with scattered boulders (Fig. D21)	Remarks			
BLUFF Photo No.____	Orientation N-S	Height 3-4	Slope 45°-60°	Length 100	Evidence of Surface Runoff ☒ No Rills Gullies	Evidence of Groundwater Seepage ☒ No Staining Damp Zone Vegetation Other	Remarks	
	Vegetation Collapsing Stable Type X (Fig. D22) Grass/trees	Remarks Most of the bluff is vegetated, but at toe, there is a distinct vertical scarp less than 1 ft high that has formed when the water level is high (Fig. D23).						
SOIL	☐ Artificial (fill) ☒ Natural	Texture Clayey sand	Color Tan	Structures No	Remarks			
NEARSHORE CONDITIONS	Bathymetry Shelf Steep Shelf/Drop off (Fig. D42) X	Texture Sand	Bedforms ☐ No Not observable	Vegetation X ☐ No Type Density	Remarks			
LANDUSE	Residential Sparse ☐ Medium ☐ Dense ☐ X	Commercial Sparse ☐ Medium ☐ Dense ☐	Agricultural	Recreational	None	Remarks Vacant log (Fig. D21)		
UPSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Gab Other X	Vegetated Bluff	Slope	Nearshore Conditions Similar	Remarks Wood bulkhead			
DOWNSTREAM CONDITIONS Photo No.____	Protective Structures B.H. RR Gab Other X	Vegetated Bluff	Slope	Nearshore Conditions Similar	Remarks			

REMARKS Reach 4a is to the north. It is 100 ft wide with bluff 10 ft high, small scarp formed on the left side at toe of large bluff (Fig. D24)

SITE NO. SCR 5a DATE _____ Weather:

Sample taken ☒ Yes ☐ No

SCR 5a

BEACH Photo No. ____	☒ Yes ☐ No	Orientation N-S	Width 1-20	Texture Gravelly sand with scattered boulders	Remarks

BLUFF Photo No. ____	Orientation N-S	Height 5-15	Slope 45°-60°	Length 1200	Evidence of Surface Runoff ☐ No Rills: X Gullies:	Evidence of Groundwater Seepage ☒ No Staining / Damp Zone / Vegetation / Other	Remarks

Vegetation Collapsing: X (Fig. D25) Stable: Grasses, brush, trees Type:	Remarks Parts of this bank at north end appear stable (Figs. D26 and D27); toe of bluff on south end has scarp 1-2 ft high at high waterline (Fig. D28)	

SOIL	☐ Artificial (fill) ☒ Natural	Texture Sandy clay	Color Grey to tan	Structures No, massive	Remarks

NEARSHORE CONDITIONS	Bathymetry Shelf / Steep / Shelf/Drop off (Fig. D42) X	Texture Sand	Bedforms ☐ No Ripples	Vegetation ☒ No Type / Density	Remarks	

LANDUSE	Residential Sparse ☐ Medium ☐ Dense ☐	Commercial Sparse ☐ Medium ☐ Dense ☐	Agricultural	Recreational	None X	Remarks Borders a road

UPSTREAM CONDITIONS Photo No.	Protective Structures B.H. X / RR / Gab / Other	Vegetated Bluff	Slope	Nearshore Conditions Similar	Remarks
DOWNSTREAM CONDITIONS Photo No. ____	Protective Structures B.H. X / RR / Gab / Other	Vegetated Bluff	Slope	Nearshore Conditions Similar	Remarks

REMARKS Reach 5b is a small vegetated bluff with a scarp at the toe (Fig. D29).

SITE NO. SCR 11b DATE _____ Weather:

Sample taken ☒ Yes ☐ No

SCR 11b

BEACH Photo No. ____	☒ Yes ☐ No	Orientation NNW-SSE	Width 0-10	Texture Gravelly sand (Fig. D30)	Remarks	
BLUFF Photo No. ____	Orientation NNW-SSE	Height 2-20	Slope 45°-60°	Length 2000	Evidence of Surface Runoff ☒ No Rills Gullies	Evidence of Groundwater Seepage ☒ No Staining Damp Zone Vegetation Other	Remarks
	Vegetation Collapsing Stable Type X (Fig. D31) Grasses and trees	Remarks Waterline at toe of bluff has formed a 1-2 ft vertical scarp at the toe along the southern part of this site (Figs. D32 and D33); north end looks more stable, grass is growing at the toe (Fig. D30)				
SOIL	☐ Artificial (fill) ☒ Natural	Texture Sandy clay	Color Tan	Structures No; looks massive	Remarks	
NEARSHORE CONDITIONS	Bathymetry Shelf Steep Shelf/Drop off (Fig. D43) X	Texture Clayey sand with scattered cobbles	Bedforms ☐ No Ripples	Vegetation ☒ No Type Density	Remarks	
LANDUSE	Residential Sparse ☐ Medium ☐ Dense ☐	Commercial Sparse ☐ Medium ☐ Dense ☐	Agricultural	Recreational	None X	Remarks Vacant lot
UPSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Gab Other X	Vegetated Bluff X	Slope	Nearshore Conditions Similar	Remarks Poured concrete over bank at scattered locations	
DOWNSTREAM CONDITIONS Photo No. ____	Protective Structures B.H. RR Gab Other X	Vegetated Bluff	Slope	Nearshore Conditions Similar	Remarks	

REMARKS Remainder of reach and 11a,c and d (Figs. D34 and D35) are similar to 11b.

SITE NO. SCR 12b DATE _____ Weather:

Sample taken ☐ Yes ☐ No

SCR 12b

BEACH Photo No.____	☐ Yes ☒ No	Orientation NE-SW	Width 0-3	Texture Sand	Remarks

BLUFF Photo No.____	Orientation NE-SW	Height 1-7	Slope 45°-60°	Length 400	Evidence of Surface Runoff ☐ No Rills Gullies	Evidence of Groundwater Seepage X ☐ No Staining Damp Zone Vegetation Other	Remarks When water level is high, waterline is at toe of bluff (Fig.D36)

Vegetation			Remarks
Collapsing	Stable	Type	Scattered riprap on south end; concrete slabs on bluff face and blocks at bluff toe; brush and logs thrown on bluff; northern part appears more stable (Fig. D38).
X	(Fig. D37)	Grass	

SOIL	☐ Artificial (fill) ☒ Natural	Texture Sand	Color Tan	Structures None observable	Remarks

NEARSHORE CONDITIONS	Bathymetry Shelf Steep Shelf/Drop off (Fig. D44) X	Texture Sand	Bedforms ☐ No None observable	Vegetation ☒ No Type Density		Remarks

LANDUSE	Residential Sparse ☐ Medium ☐ Dense ☐	Commercial Sparse ☐ Medium ☐ Dense ☐	Agricultural	Recreational	None X	Remarks Borders a road

UPSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Gab Other X	Vegetated Bluff	Slope	Nearshore Conditions Similar	Remarks
DOWNSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Gab Other X	Vegetated Bluff X	Slope	Nearshore Conditions Similar	Remarks

REMARKS

SITE NO. SCR 17 DATE _____ Weather:

Sample taken ☐ Yes ☐ No

SCR 17

BEACH Photo No. ____	☐ Yes ☐ No	Orientation N-S	Width 3-10	Texture Gravelly sand (Fig. D39)	Remarks					
BLUFF Photo No. ____	Orientation N-S	Height 1-2	Slope Nearly vertical	Length 500	Evidence of Surface Runoff X ☐ No Rills Gullies	Evidence of Groundwater Seepage ☐ No Staining Damp Zone Vegetation Other	Remarks			
	Vegetation Collapsing X	Stable	Type	Remarks Clumps of grass scattered along toe of bluff (Fig. D40); where trees are at the water line amount of recession is less (Fig. D41)						
SOIL	☐ Artificial (fill) X ☐ Natural	Texture Sand over clay	Color Brown. top soil, tan clay	Structures No	Remarks Shows clear soil profile					
NEARSHORE CONDITIONS	Bathymetry Shelf X	Steep (Fig. D44)	Shelf/Drop off X	Texture Sand with scattered rocks	Bedforms ☐ No X	Vegetation ☐ No X Type Density	Remarks Several offshore linear depressions parallel to beach along the shelf			
LANDUSE	Residential Sparse ☐ Medium ☐ Dense ☐	Commercial Sparse ☐ Medium ☐ Dense ☐	Agricultural	Recreational X	None	Remarks Algonac State Park				
UPSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Gab Other X	Vegetated Bluff	Slope	Nearshore Conditions Similar	Remarks Gabion on beach at north end					
DOWNSTREAM CONDITIONS Photo No. ____	Protective Structures B.H. RR Gab Other X	Vegetated Bluff	Slope	Nearshore Conditions Similar	Remarks					

REMARKS

Figure D17. SCR reach 3a, 19 May 79.

Figure D18. SCR reach 3a, north end, 19 May 79.

Figure D19. SCR reach 3a, 31 Oct 78.

Figure D20. SCR reach 3b, 20 May 78.

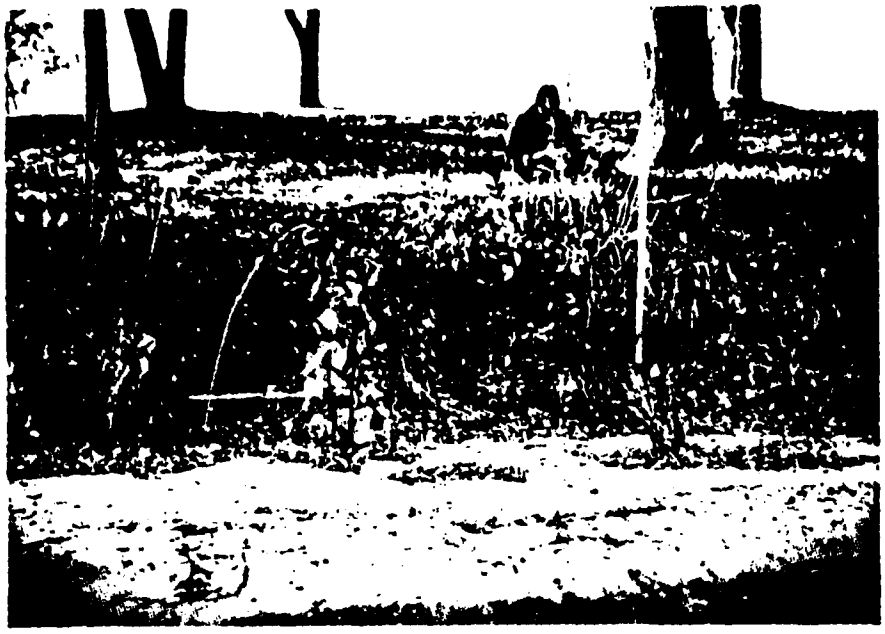


Figure D21. SCR reach 4b, 31 Oct 78.

Figure D22. SCR reach 4b, 31 Oct 78.

Figure D23. SCR reach 4b, 31 Oct 78.

Figure D24. SCR reach 4a, 18 Oct 77.

Figure D25. SCR reach 5a, 18 Oct 77.

Figure D26. SCR reach 5a, north end, 18 Oct 77.

Figure D27. SCR reach 5a, 19 May 79.

Figure D28. SCR reach 5a, 4 Oct 79.

Figure D29. SCR reach 5b, 23 May 77.

Figure D30. SCR reach 11b, north end, 19 May 79.

Figure D31. SCR reach 11b, 23 May 77.

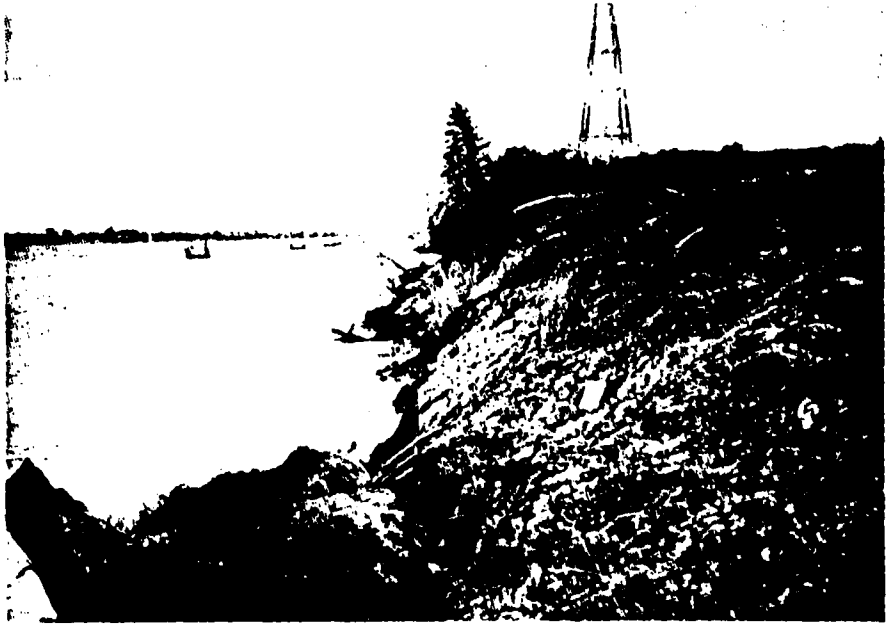


Figure D32. SCR reach 11b, 19 May 79.

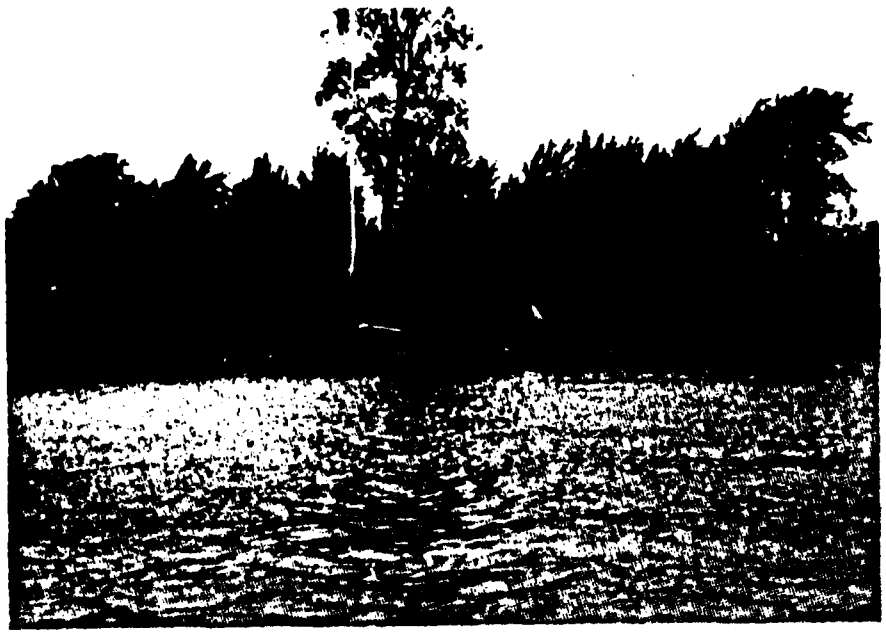


Figure D33. SCR reach 11b, 23 May 77.

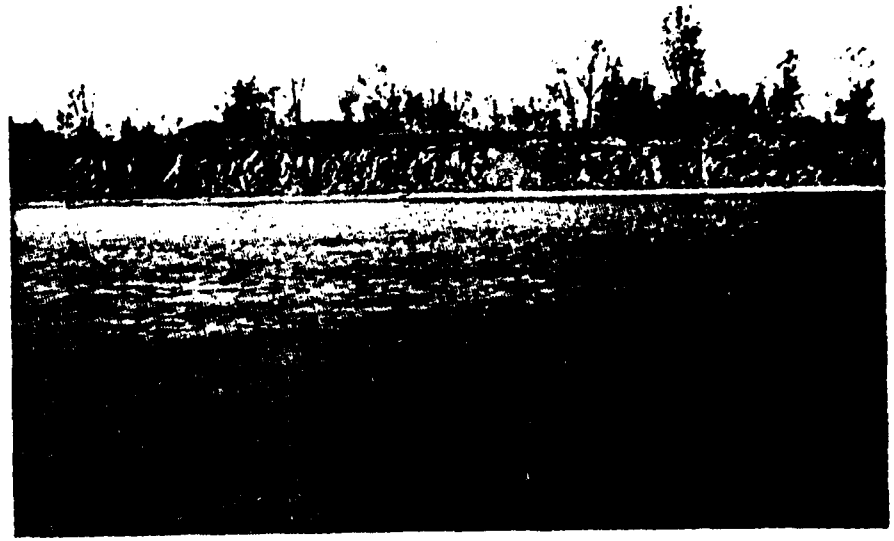


Figure D34. SCR reach 11a, 18 Oct 77.

Figure D35. SCR reach 11d, 18 Oct 77.

Figure D36. SCR reach 12b, 4 Oct 77.

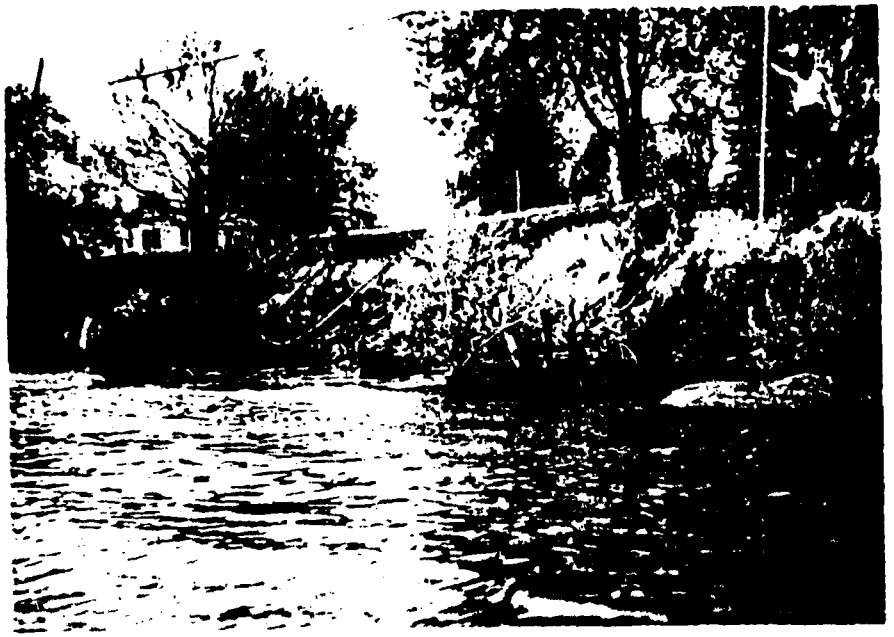


Figure D37. SCR reach 12b, 19 May 79.

Figure D38. SCR reach 12b, 18 Oct 77.

Figure D39. SCR reach 17, 19 May 79.

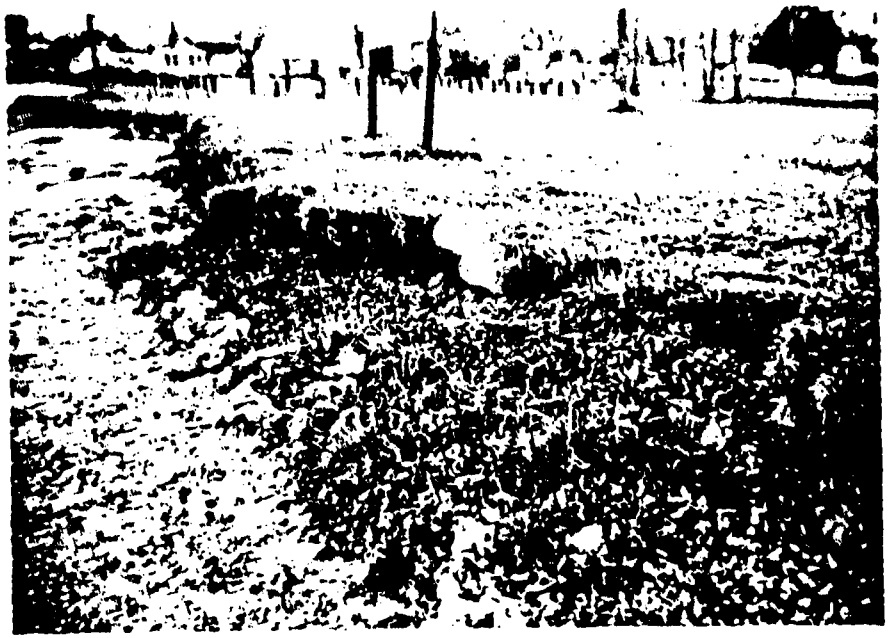


Figure D40. SCR reach 17, 30 May 78.

Figure D41. SCR reach 17, 23 May 77.

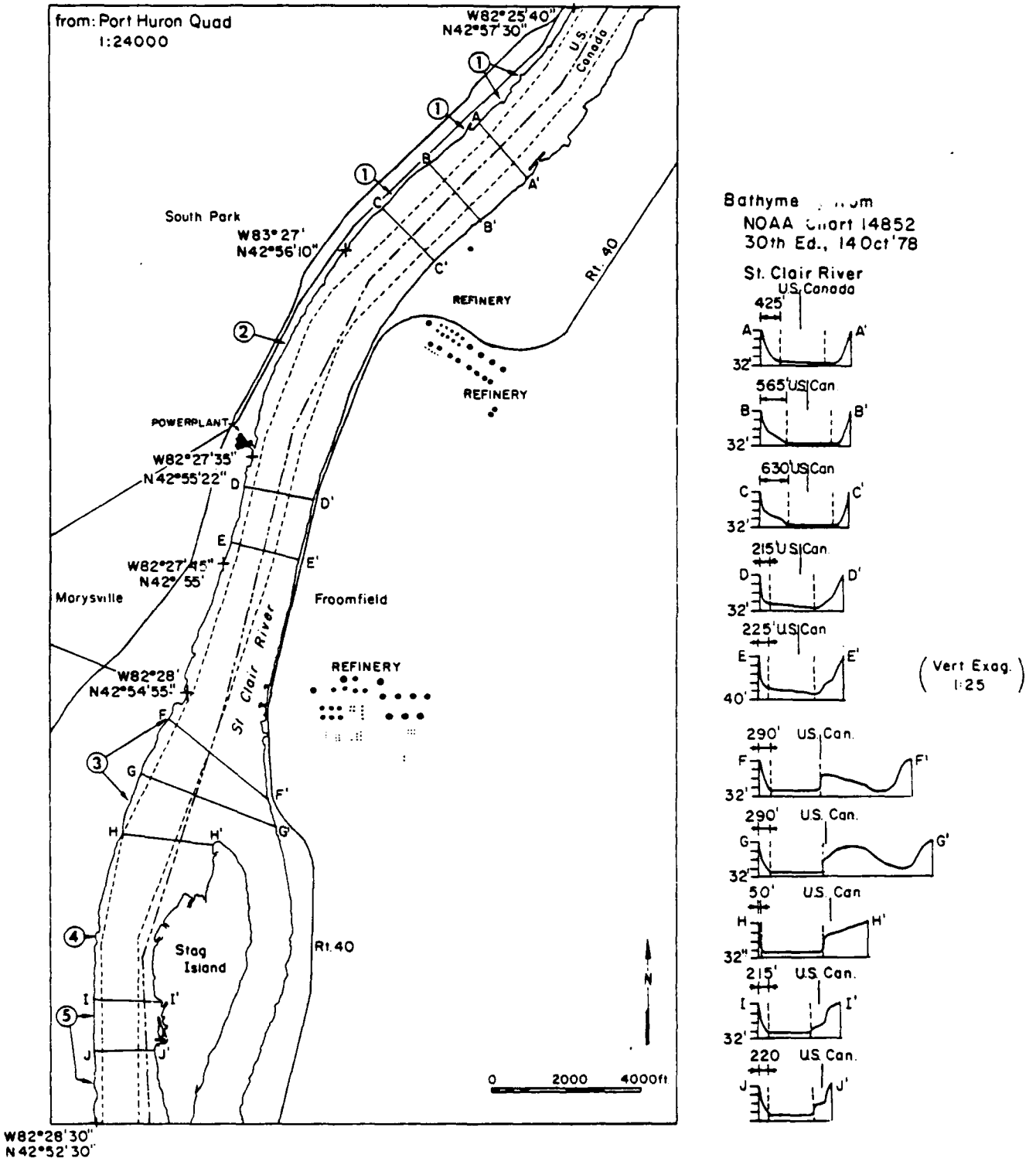


Figure D42. Generalized river cross-sections, sites 1 to 5, St. Clair River.

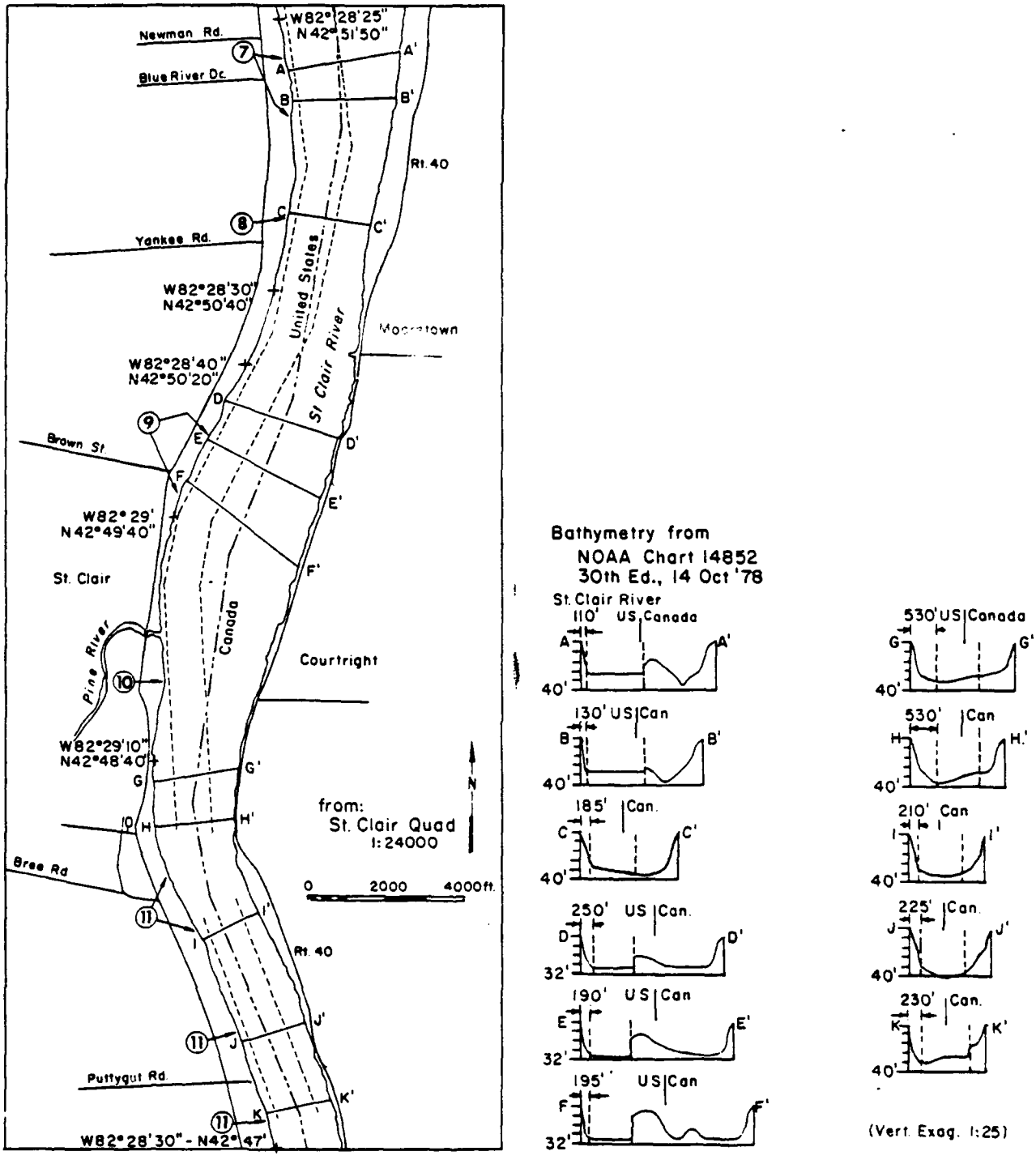


Figure D43. Generalized river cross-sections, sites 6 to 11, St. Clair River.

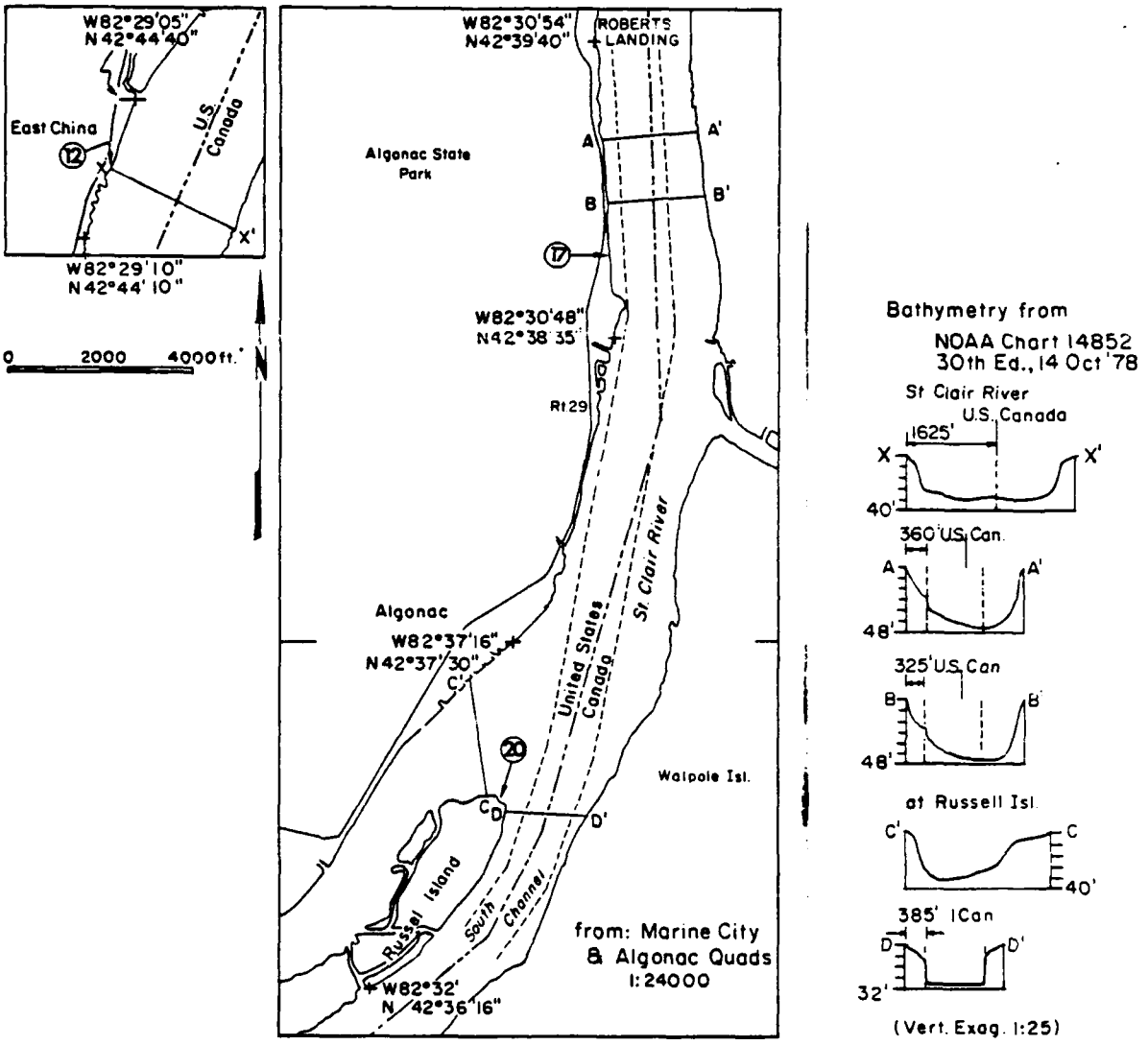
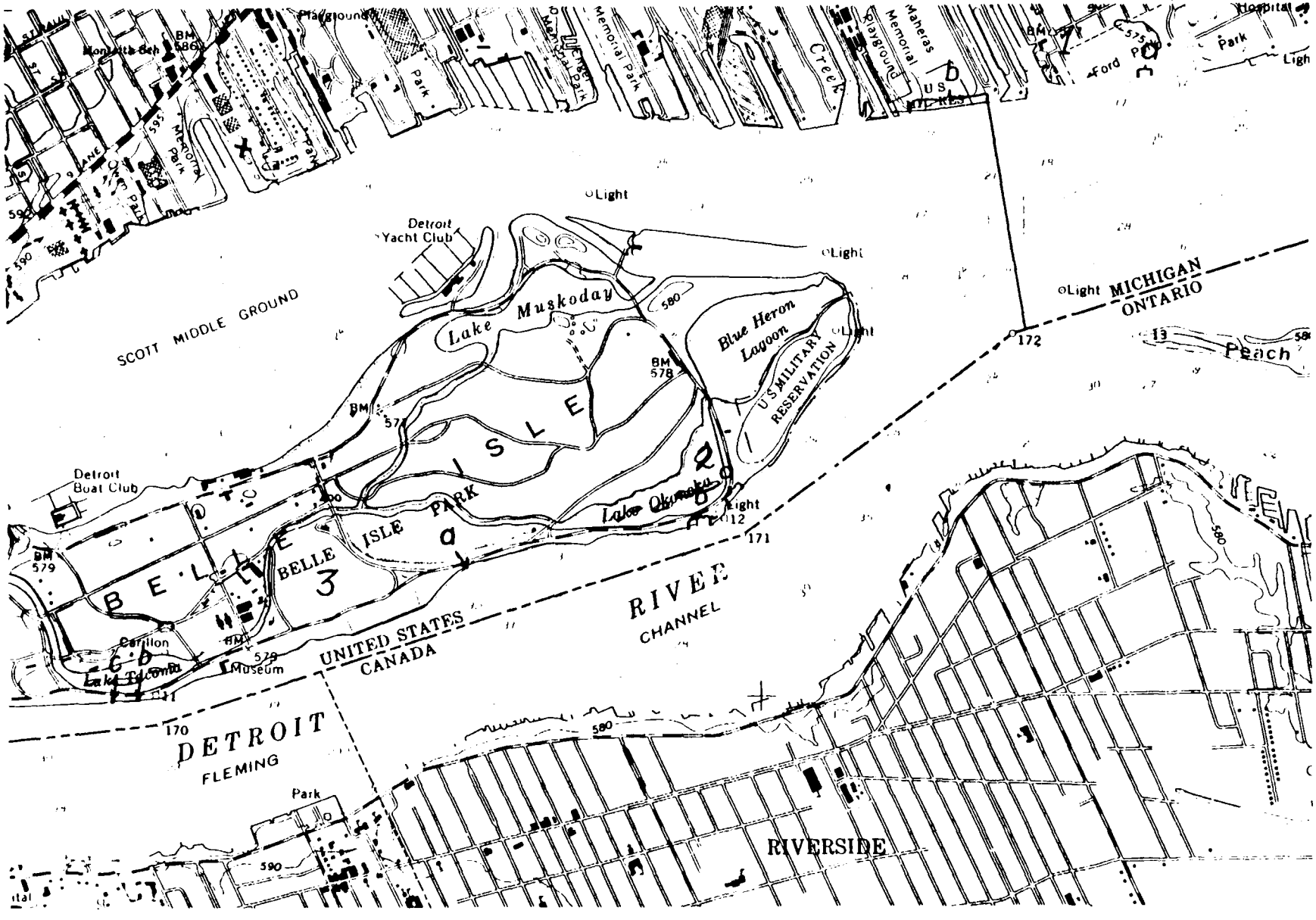


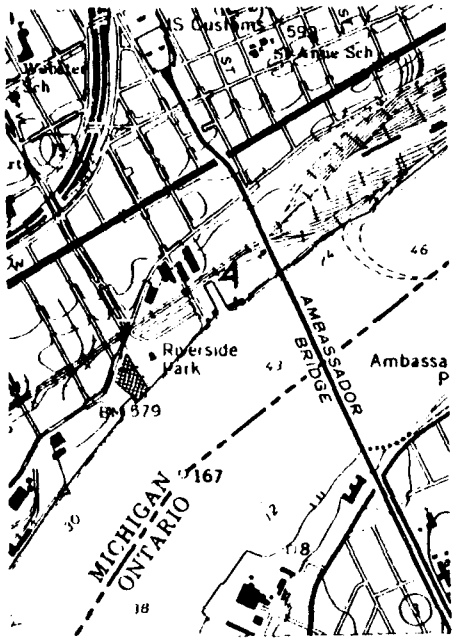
Figure D44. Generalized river cross-sections, sites 13 to 20, St. Clair River.

Detroit River

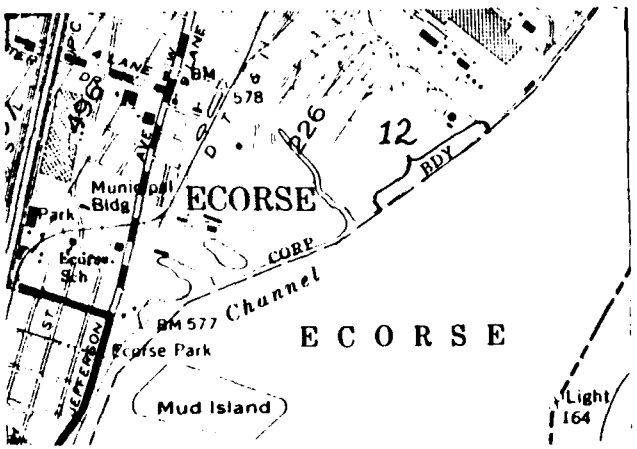
Locations of partially vegetated and bare banks (shown on portions of U.S.G.S. 7-1/2 minute-series topographic maps).



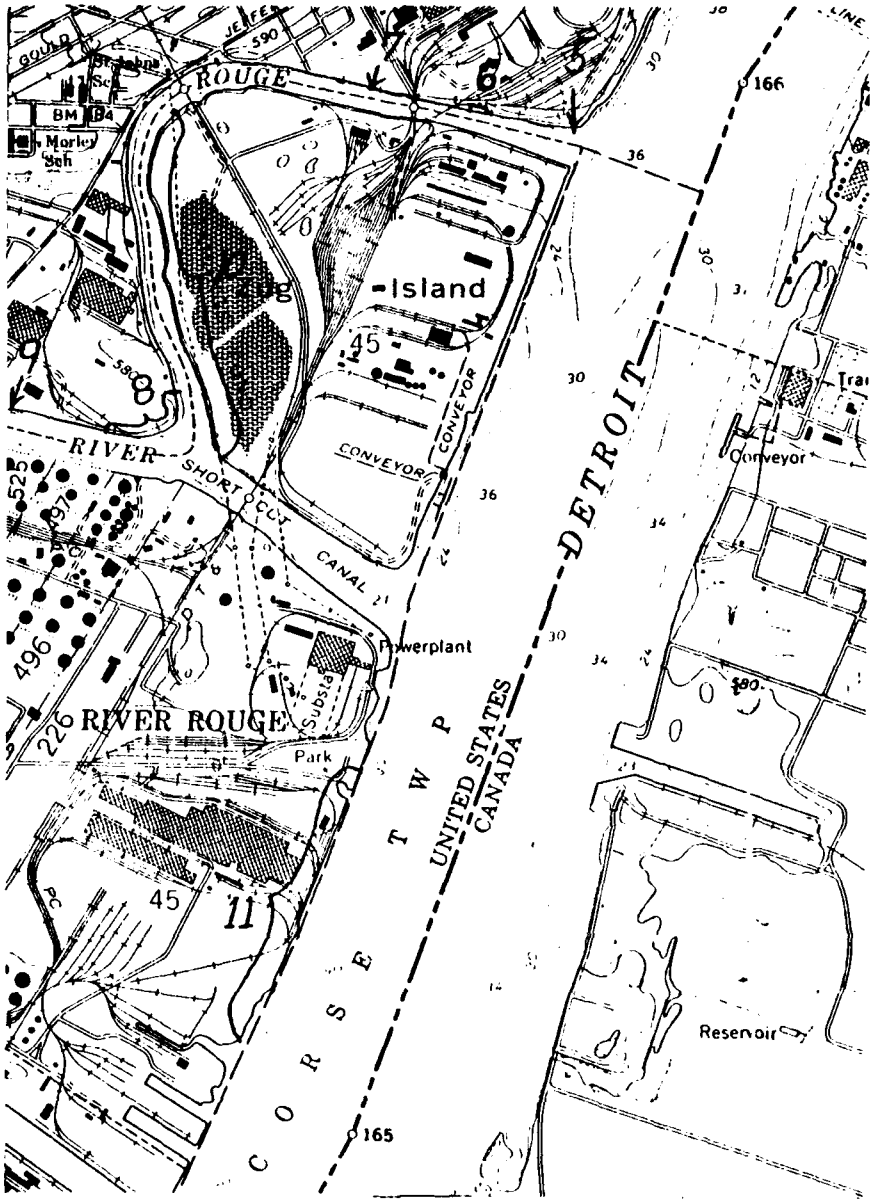
DR sites 1, 2 and 3 (Belle Isle, Mich., 1973).



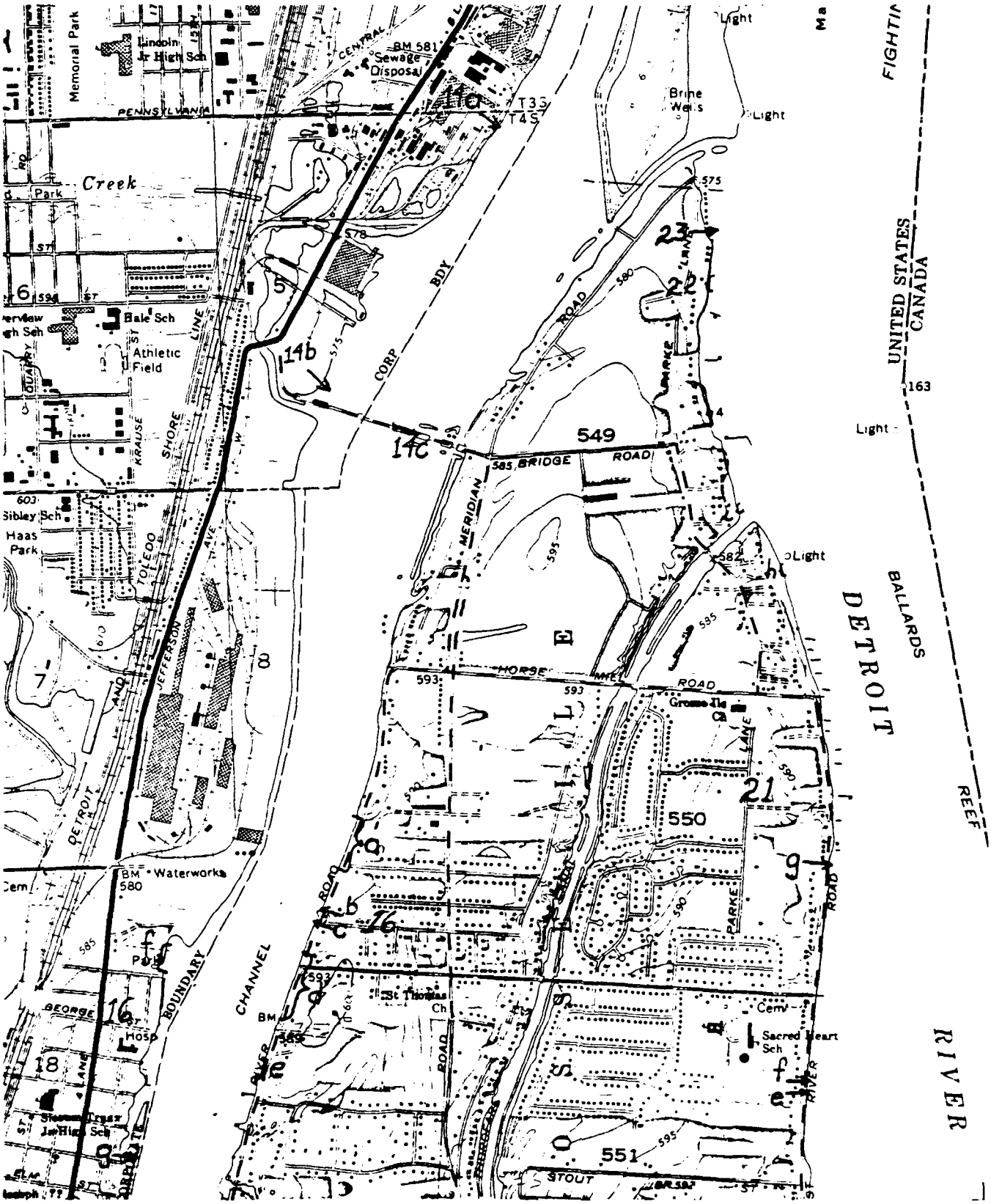
DR site 4 (Detroit, Mich., 1973).



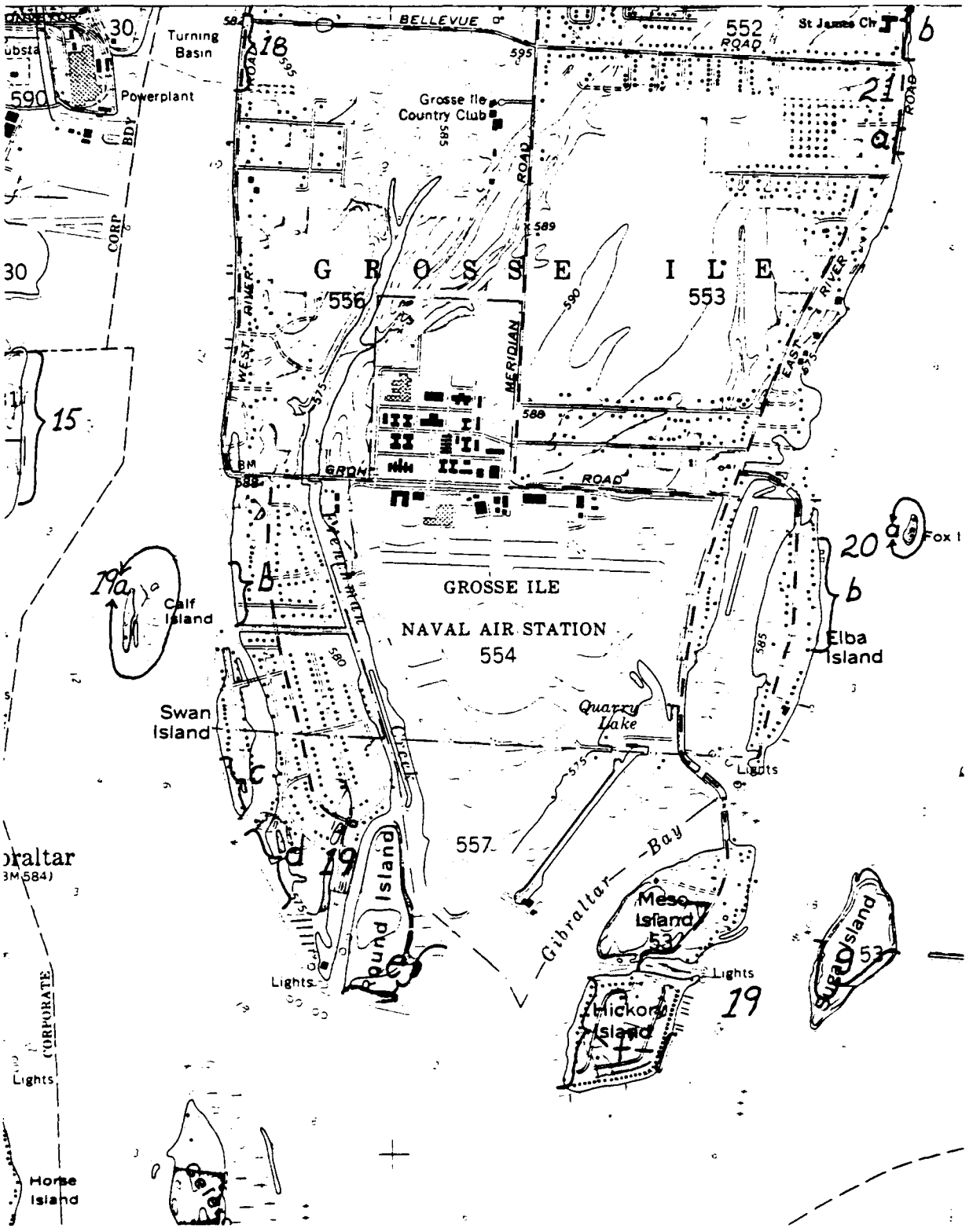
DR site 12 (Wyandotte, Mich., 1973).



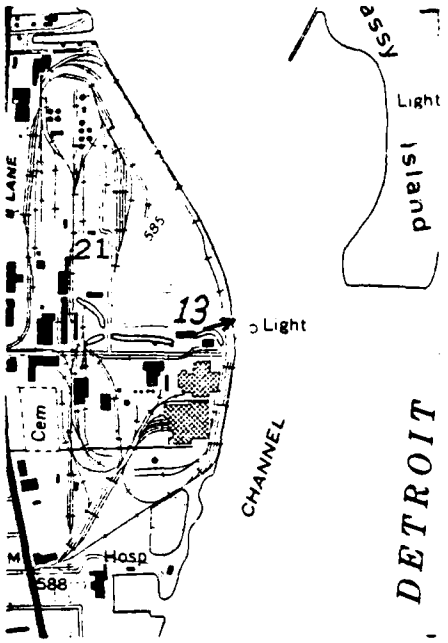
DR sites 5, 6, 7, 8, 9, 10 and 11 (Detroit, Mich., 1973).



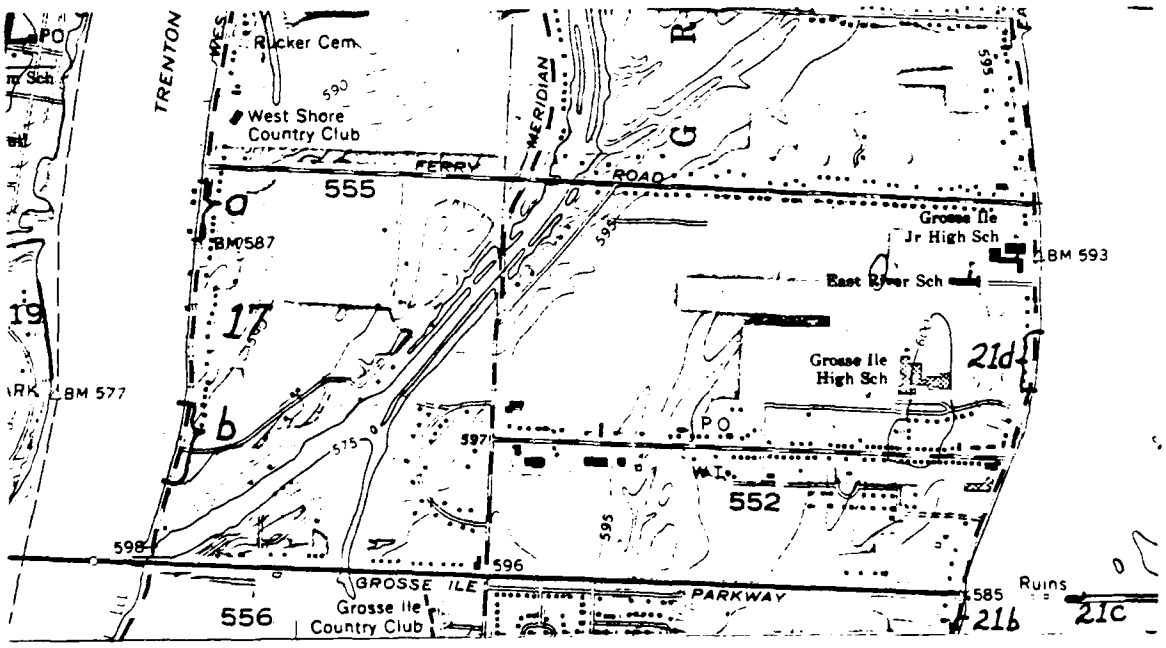
DR sites 14, 16, 21, 22 and 23 (Wyandotte, Mich., 1973).



DR sites 15, 18, 19, 20 and 21 (Rockwood, Mich., 1973).



DR site 13 (Wyandotte, Mich., 1973).

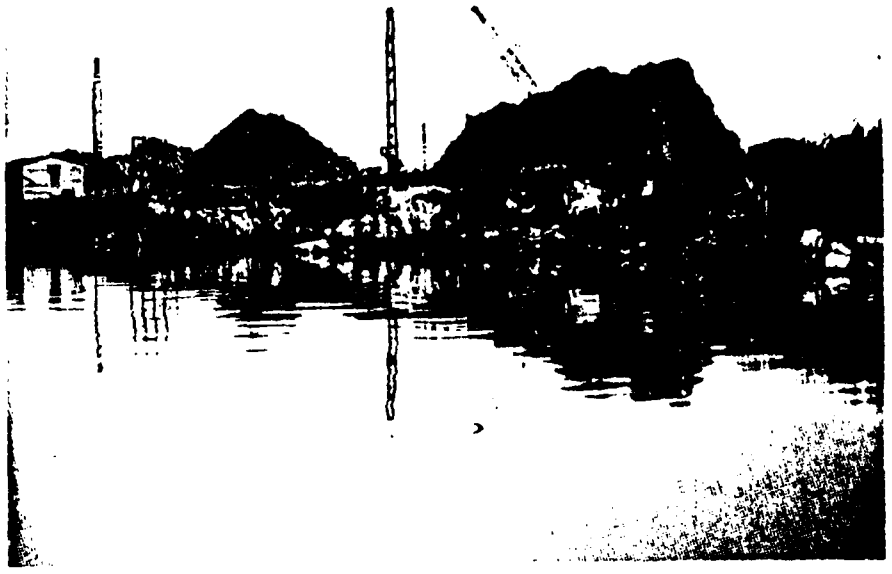


DR sites 17 and 21 (Wyandotte, Mich., 1973).

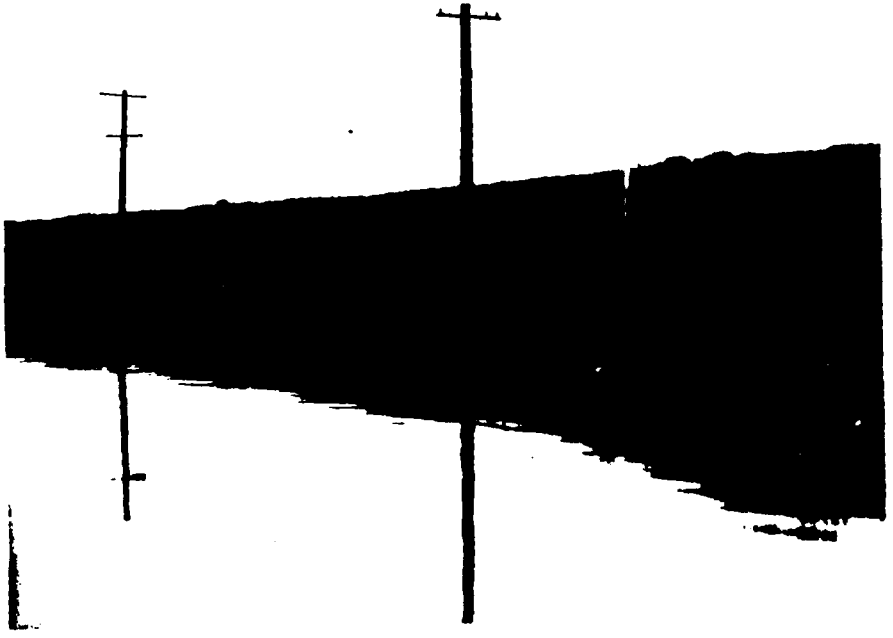
Detroit River

Selected photographs that illustrate
the diversity of the eroding banks;
not all eroding banks are shown.

DR site 6, 24 May 77



DR site 8, 24 May 77



DR site 10, 24 May 77

DR reach 14c, 30 May 80

DR reach 16d, 24 May 77

DR reach 16f, 30 May 80

DR reach 21b, 19 Oct 77

DR reach 21c, 30 May 80

DR site 18, 19 Oct 77

DR reach 19b, 30 May 80

DR reach 19b, 19 Oct 77

DR reach 19c, 30 May 80

DR reach 19d, 19 Oct 77

DR reach 19d, 19 Oct 77

DR reach 19e, 19 Oct 77

DR reach 19f, 30 May 80

DR reach 19g, 30 May 80

DR reach 20a, 30 May 80

DR reach 20b, 19 Oct 77

DR reach 21a, 19 Oct 77

DR reach 21d, 19 Oct 77

DR site 22, 24 May 77

DR site 23, 21 May 78

Detroit River

Descriptions, photographs and generalized river cross-sections for profiled reaches, some eroding reaches and selected sites (distances in feet).

SITE NO. DR 1a DATE _____ Weather:

Sample taken ☐ Yes ☐ No

DR 1a

BEACH Photo No. ____	☒ Yes ☐ No	Orientation ENE-WSW	Width 5-15	Texture Gravel and sand with cobbles and boulders	Remarks Scattered concrete slabs riprap (Fig. D45)

BLUFF Photo No. ____	Orientation ENE-WSW	Height 1-2 (Fig. D46)	Slope 45°-90°	Length 200	Evidence of Surface Runoff ☐ No Rills Gullies	Evidence of Groundwater Seepage ☒ No Staining Damp Zone Vegetation Other	Remarks

	Vegetation Collapsing Stable Type X Grass	Remarks Sheet metal bulkhead was built on western end

SOIL	☐ Artificial (fill) ☒ Natural	Texture Gravelly sand	Color Grey	Structures Not observable	Remarks

NEARSHORE CONDITIONS	Bathymetry Shelf Steep Shelf/Drop off X (Fig. D58)	Texture Gravel	Bedforms ☐ No Not observable	Vegetation ☐ No Type Density	Remarks

LANDUSE	Residential Sparse ☐ Medium ☐ Dense ☐	Commercial Sparse ☐ Medium ☐ Dense ☐	Agricultural	Recreational Park	None	Remarks

UPSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Gab Other X	Vegetated Bluff	Slope	Nearshore Conditions Similar	Remarks

DOWNSTREAM CONDITIONS Photo No. ____	Protective Structures B.H. RR Gab Other X	Vegetated Bluff	Slope	Nearshore Conditions Similar	Remarks Built between May 1977 and Oct. 1978

REMARKS

SITE NO. DR 2a DATE _____ Weather:

Sample taken [X] Yes [ ] No

DR 2a

BEACH Photo No. ____	[X] Yes [ ] No	Orientation NE-SW	Width 3-10	Texture Sand with gravel (Fig. D47)	Remarks Concrete slabs scattered along water line (Fig. D48)

BLUFF Photo No. ____	Orientation NE-SW	Height .5-2	Slope No distinct bluff (Fig. D47)	Length 300	Evidence of Surface Runoff [X] No Rills Gullies	Evidence of Groundwater Seepage [X] No Staining Damp Zone Vegetation Other	Remarks Clumps of fallen grass

	Vegetation Collapsing Stable Type X Grass	Remarks

SOIL	[ ] Artificial (fill) [X] Natural	Texture Sand	Color Grey	Structures None observable	Remarks

NEARSHORE CONDITIONS	Bathymetry Shelf Steep Shelf/Drop off (Fig. D58) X	Texture Sand with scattered boulders	Bedforms [ ] No None observable	Vegetation [X] No Type Density		Remarks

LANDUSE	Residential Sparse [ ] Medium [ ] Dense [ ]	Commercial Sparse [ ] Medium [ ] Dense [ ]	Agricultural	Recreational Park	None	Remarks	

UPSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Gab Other X	Vegetated Bluff X	Slope	Nearshore Conditions Similar	Remarks Scattered riprap
DOWNSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Gab Other X	Vegetated Bluff	Slope	Nearshore Conditions Similar	Remarks Coast Guard Station

REMARKS

SITE NO. DR 2b DATE _____ Weather:

Sample taken ☐ Yes ☐ No

DR 2b

BEACH Photo No. ____	☐ Yes ☐ No	Orientation E-W	Width 3-15	Texture Gravelly sand	Remarks Concrete slabs and boulders scattered along beach near the water-line; grass growing on beach (Fig. D49)

BLUFF Photo No. ____	Orientation E-W	Height 0-.75	Slope ---	Length 300	Evidence of Surface Runoff ☒ No Rills Gullies	Evidence of Groundwater Seepage ☒ No Staining Damp Zone Vegetation Other	Remarks

	Vegetation Collapsing Stable Type X Grass	Remarks Most of reach has no distinct bluff

SOIL	☐ Artificial (fill) ☒ Natural	Texture Sand	Color Tan	Structures None observable	Remarks

NEARSHORE CONDITIONS	Bathymetry Shelf Steep Shelf/Drop off (Fig. D58) X	Texture Sand	Bedforms ☒ No Not observable	Vegetation ☒ No Type Density	Remarks

LANDUSE	Residential Sparse ☐ Medium ☐ Dense ☐	Commercial Sparse ☐ Medium ☐ Dense ☐	Agricultural	Recreational Park	None	Remarks

UPSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Gab Other X	Vegetated Bluff	Slope	Nearshore Conditions Similar, but shelf not as wide	Remarks

DOWNSTREAM CONDITIONS Photo No	Protective Structures B.H. RR Gab Other X	Vegetated Bluff	Slope	Nearshore Conditions Similar	Remarks

REMARKS

SITE NO. DR 16a DATE _____ Weather:

Sample taken ☒ Yes ☐ No

DR 16a

BEACH Photo No. ____	☒ Yes ☐ No	Orientation NNE-SSW	Width 0-3	Texture Gravelly sand	Remarks Trees, brush and grass clumps near toe of bluff			
BLUFF Photo No. ____	Orientation NNW-SSW	Height 10-15	Slope 50°-90°	Length 800	Evidence of Surface Runoff ☐ No Rills Gullies X	Evidence of Groundwater Seepage ☐ No Staining Damp Zone Vegetation Other	Remarks	
	Vegetation Collapsing Stable Type X Grass/trees	Remarks During most of the surveys, waterline was at the base of the bluff; several trees were ready to fall into river; trees roots exposed along bluff (Fig. D50)						
SOIL	☐ Artificial (fill) ☒ Natural	Texture Sandy and gravelly clay	Color Tan	Structures Weak layering	Remarks			
NEARSHORE CONDITIONS	Bathymetry Shelf Steep Shelf/Drop off (Fig. D59) X	Texture Sand gravel	Bedforms ☐ No Not observable	Vegetation ☒ No Type Density	Remarks			
LANDUSE	Residential Sparse ☐ Medium ☐ Dense ☐	Commercial Sparse ☐ Medium ☐ Dense ☐	Agricultural	Recreational	None X	Remarks Bluff borders a road		
UPSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Gab Other X	Vegetated Bluff	Slope	Nearshore Conditions Similar	Remarks Riprap scattered and of variable type			
DOWNSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Gab Other X	Vegetated Bluff	Slope	Nearshore Conditions Similar (Fig. D51)	Remarks Scattered and variable			

REMARKS Figure D52 shows typical shoreline along site 16.

SITE NO. DR 16f DATE _____ Weather:

Sample taken ☒ Yes ☐ No

DR 16f

BEACH Photo No. _____	☒ Yes ☐ No	Orientation N-S	Width 0-5	Texture Sandy gravel	Remarks Waterline at base of bluff on south end of reach (Fig. D53); concrete slabs are scattered along the beach

BLUFF Photo No. _____	Orientation N-S	Height 1-6	Slope 40°-90°	Length 400	Evidence of Surface Runoff ☒ No Rills Gullies	Evidence of Groundwater Seepage X ☐ No Staining Damp Zone Vegetation Other	Remarks Bluff higher on north end; being undercut on south end (Fig. D51)

	Vegetation Collapsing Stable Type X Grass	Remarks Man-made changes here may be more important that natural changes; there are numerous trails up and down the bluff along this reach

SOIL	☒ Artificial (fill) ☒ Natural	Texture Sandy and gravely clay	Color Tan-gre[illegible]	Structures Layered	Remarks

NEARSHORE CONDITIONS	Bathymetry Shelf Steep Shelf/Drop off (Fig. D59) X	Te[illegible] Sand [illegible] cohesive clay offshore	Bedforms ☒ No Not observable	Vegetation ☒ No Type Density	Remarks Oil saturates the clay further offshore along the shelf

LANDUSE	Residential Sparse ☒ Medium ☒ Dense ☒	Commercial Sparse ☒ Medium ☐ Dense ☐	Agricultural	Recreational Park	None	Remarks

UPSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Cab Other X	Vegetated Bluff	Slope	Nearshore Conditions Similar	Remarks Shelf narrower
DOWNSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Cab Other X	Vegetated Bluff	Slope	Nearshore Conditions Similar	Remarks Shelf narrower

REMARKS

SITE NO. DR 18 DATE _____ Weather:

Sample taken ☒ Yes ☐ No

DR 18 (north)

BEACH Photo No. _____	☒ Yes ☐ No	Orientation N-S	Width 0-15	Texture Sand with cobbles and boulders	Remarks Grass growing on beach and debris and scattered concrete slabs at the waterline (Fig. D55)

BLUFF Photo No. ____	Orientation N-S	Height 5-15	Slope 50°-90°	Length 1000	Evidence of Surface Runoff ☒ No Rills Gullies	Evidence of Groundwater Seepage ☒ No Staining Damp Zone Vegetation Other	Remarks

	Vegetation Collapsing Stable Type X Grass/trees	Remarks Bluff slope is less and much of bluff is vegetated on north end of site. North end looks more stable.

SOIL	☐ Artificial (fill) ☒ Natural	Texture Sandy clay	Color Tan	Structures Layering	Remarks Sandy gravel layers

NEARSHORE CONDITIONS	Bathymetry Shelf Steep Shelf/Drop off (Fig. D55) X	Texture sandy gravel on top of clay	Bedforms ☒ No	Vegetation ☐ No Type Density Grasses Sparse	Remarks Very soft bottom approximately 10 ft off-shore

LANDUSE	Residential Sparse ☐ Medium ☐ Dense ☐	Commercial Sparse ☐ Medium ☐ Dense ☐	Agricultural	Recreational	None X	Remarks Borders a road

UPSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Gab Other X	Vegetated Bluff X	Slope	Nearshore Conditions Similar	Remarks Scattered riprap
DOWNSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Gab Other X	Vegetated Bluff	Slope	Nearshore Conditions Variable (Fig. D56)	Remarks

REMARKS Rest of Site 18 has scattered bluffs, few trees sliding into water (Fig. D57).

Figure D45. DR reach 1a, 30 Oct 78.

Figure D46. DR reach 1a, 23 May 77.

Figure D47. DR reach 2a, 20 May 79.

Figure D48. DR reach 2a, 30 Oct 78.

Figure D49. DR reach 2b, 30 Oct 78.

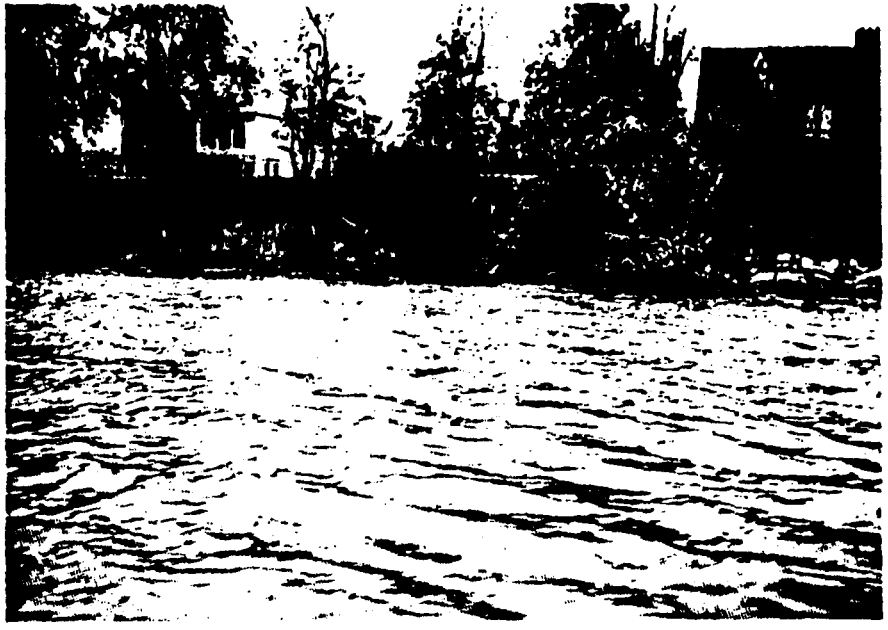


Figure D50. DR reach 16a, 21 May 78.

Figure D51. DR reach 17a, 24 May 77.

Figure D52. DR reach 16a, 24 May 77.

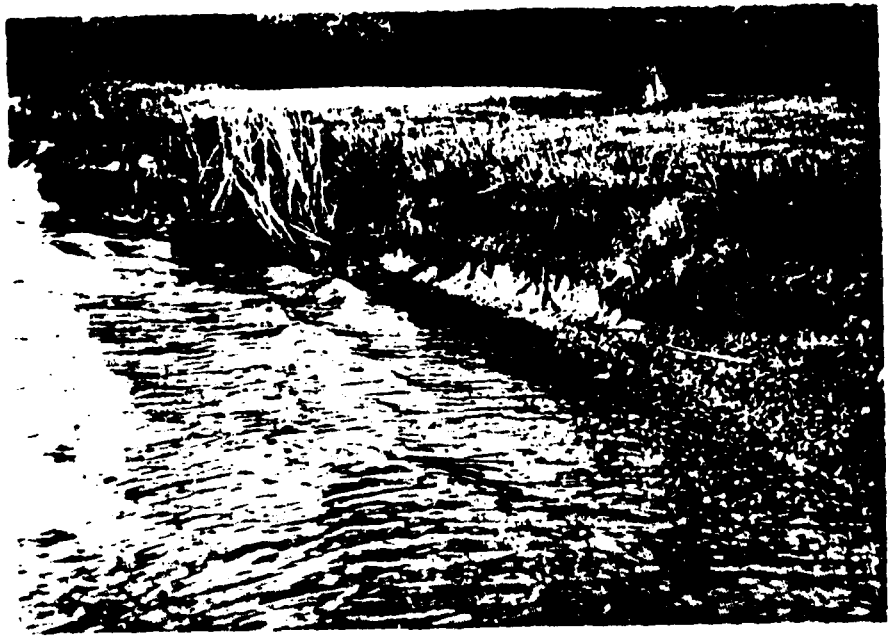


Figure D53. DR reach 16f, 21 May 78.

Figure D54. DR reach 16f, north end, 20 May 79.

Figure D55. DR reach 18, north end, 20 May 79.

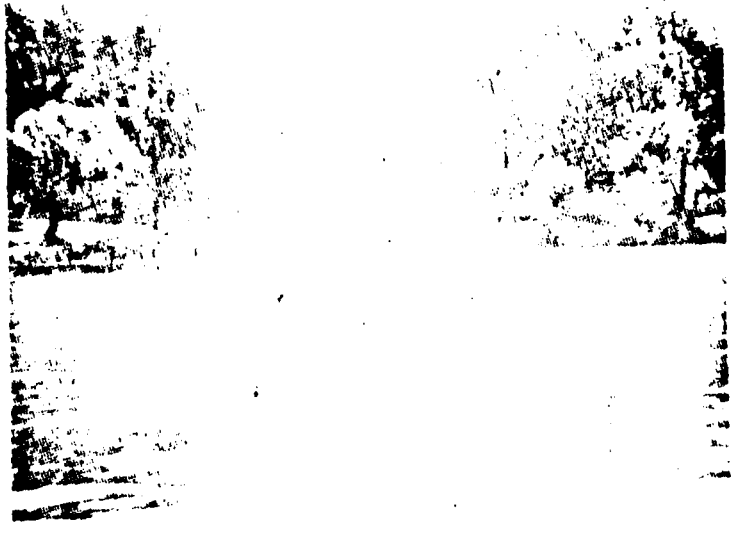
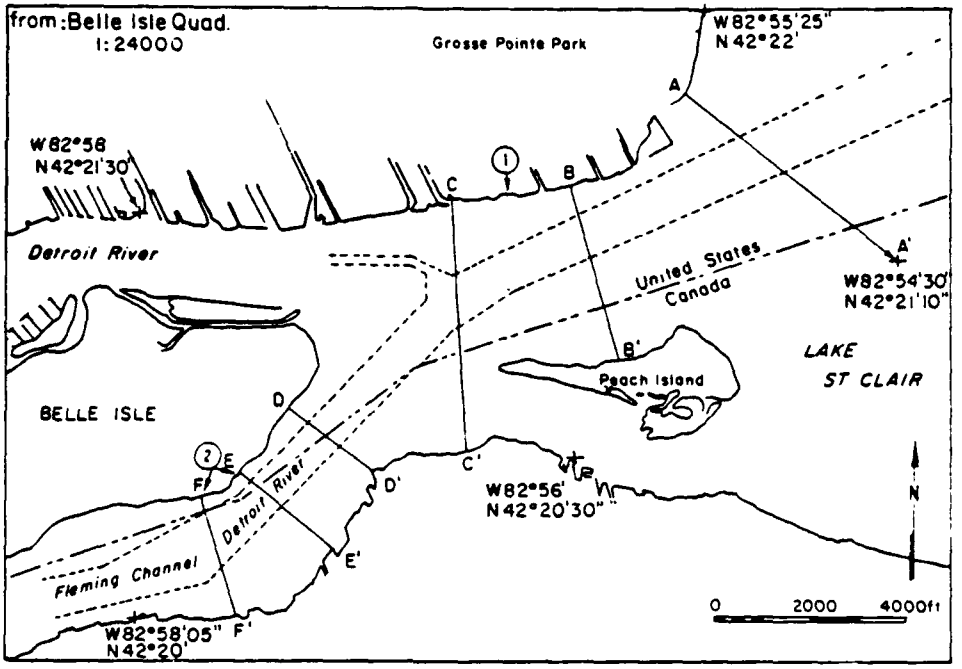


Figure D56. DR reach 18, south end, 24 May 77.

Figure D57. DR reach 18, south end, 21 May 78.



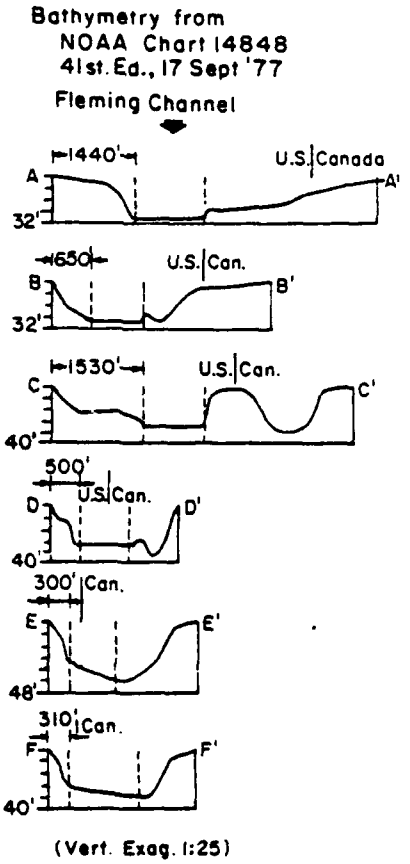


Figure D58. Generalized river cross-sections, sites 1 and 2, Detroit River.

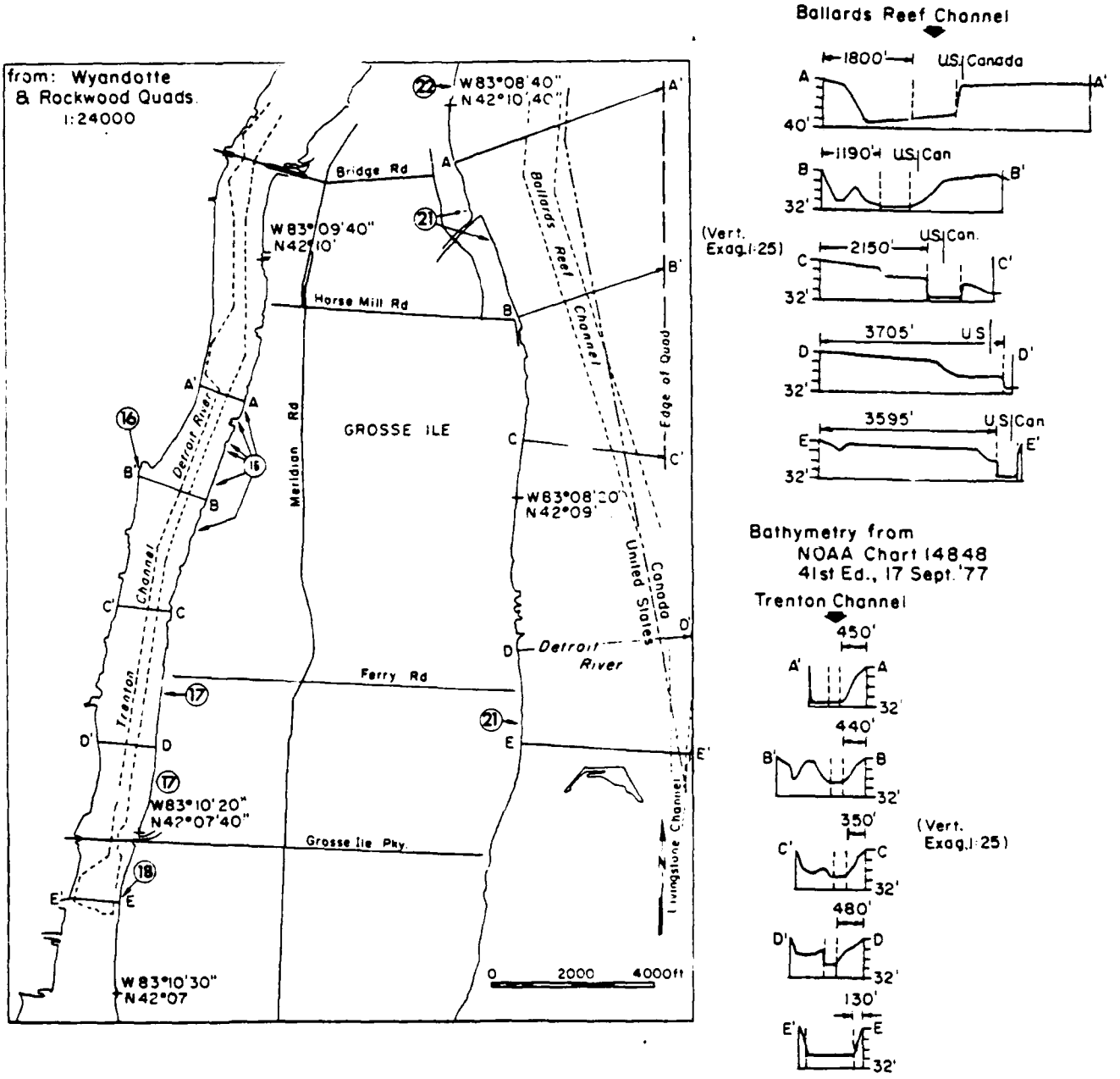
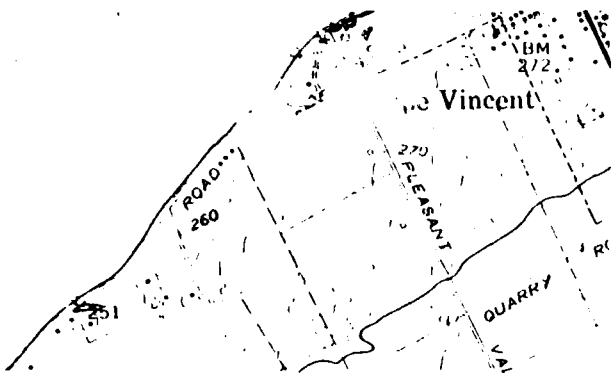


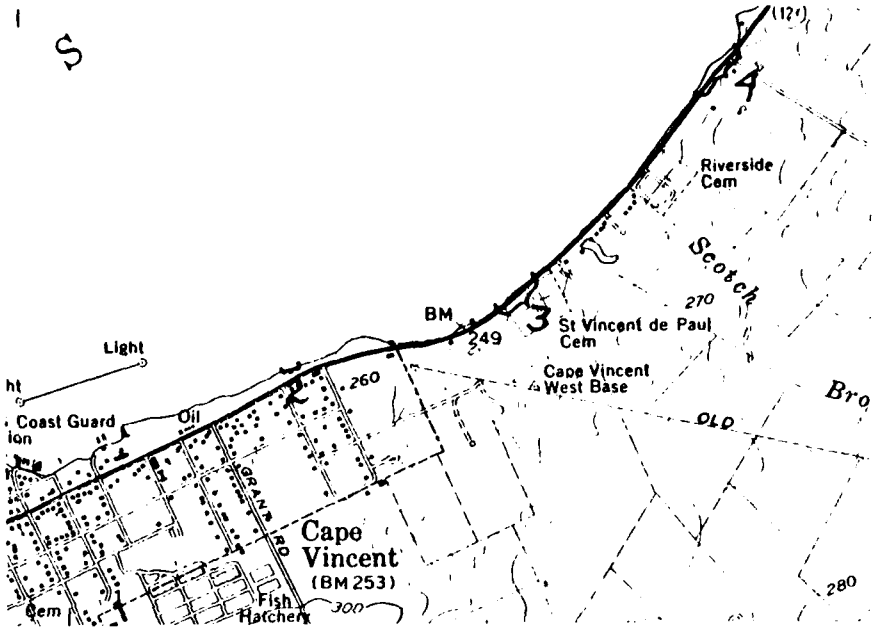
Figure D59. Generalized river cross-sections, sites 16, 17, 18, 21, 22 and 23, Detroit River.

St. Lawrence River

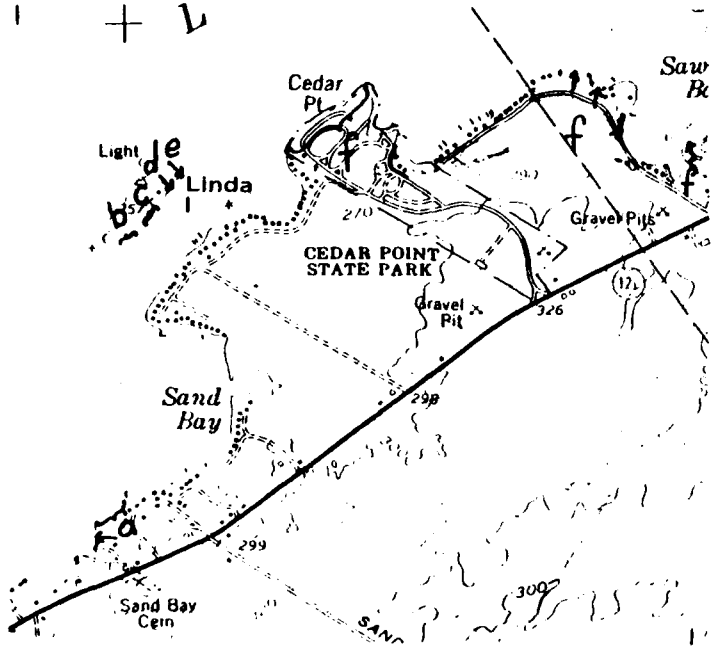
Locations of partially vegetated and bare banks (shown on portions of U.S.G.S. 7-1/2 minute-series topographic maps).



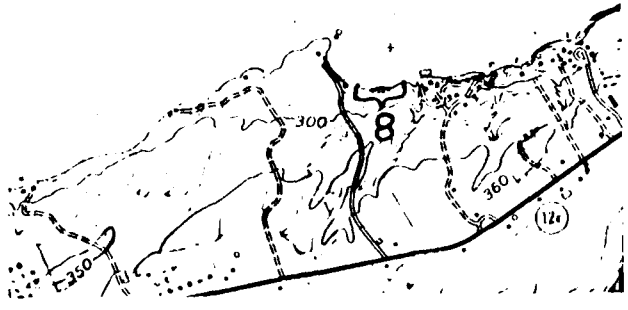
SLR site 1 (Cape Vincent South, N.Y., 1958).



SLR sites 2, 3 and 4 (Cape Vincent North, N.Y., 1958).

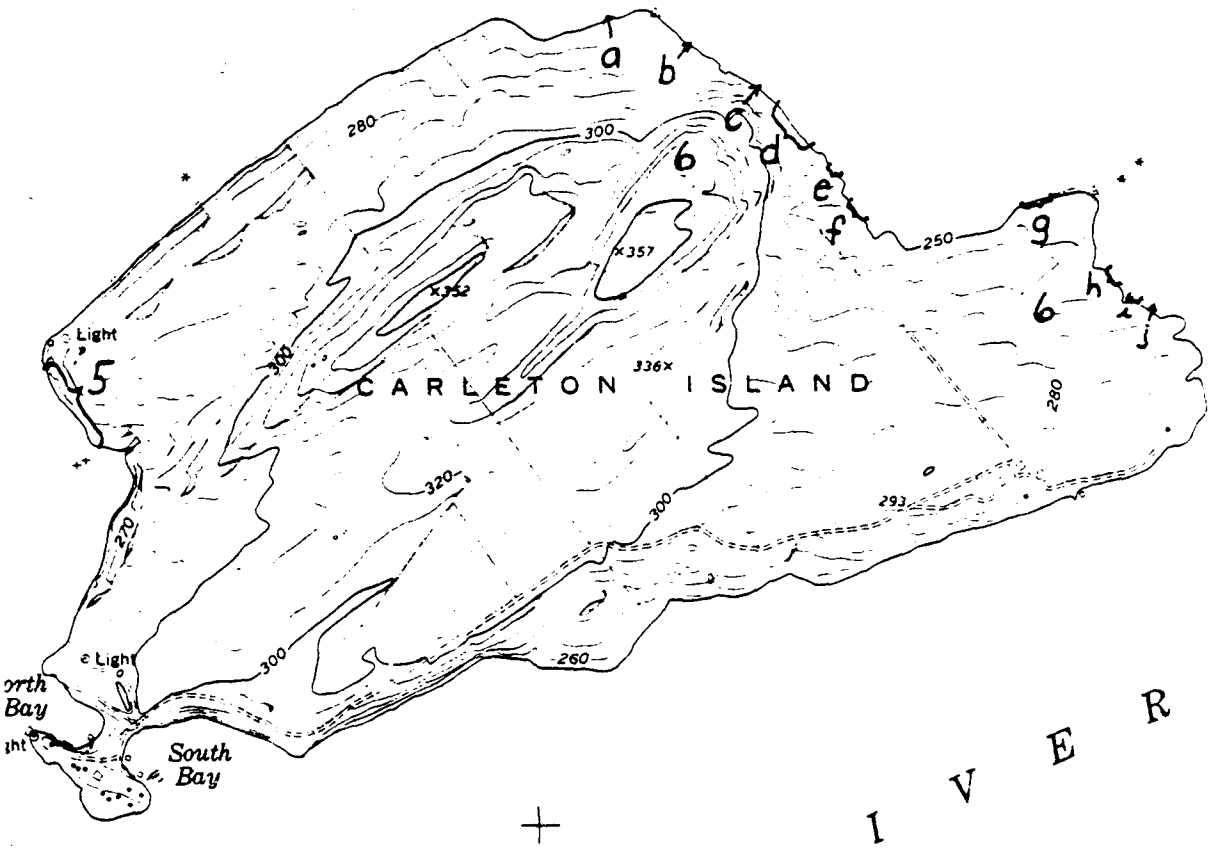


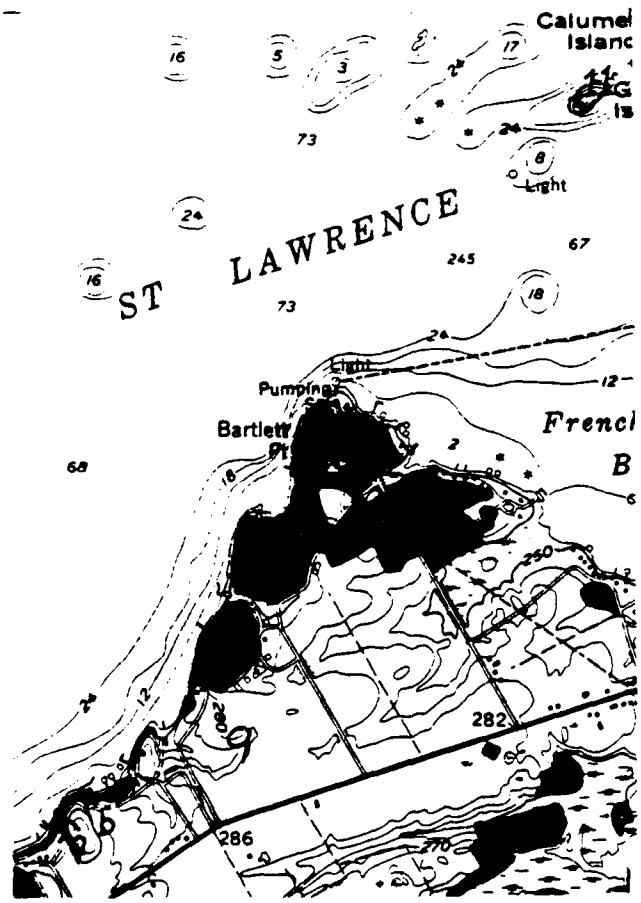
SLR site 7 (Saint Lawrence, N.Y., 1958).



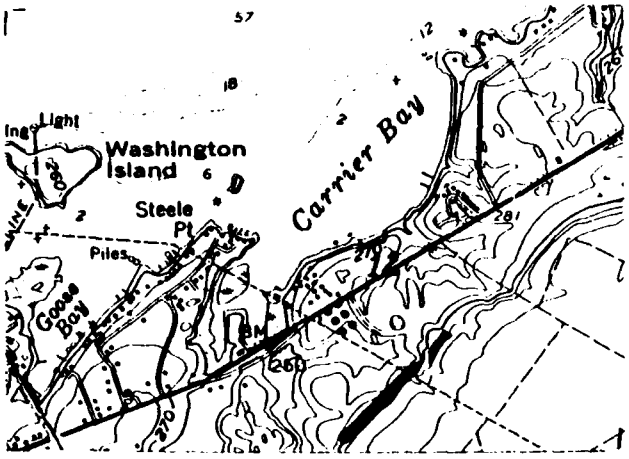
SLR site 8 (Saint Lawrence, N.Y., 1958).

SLR sites 5 and 6 (Cape Vincent North, N.Y., 1958).

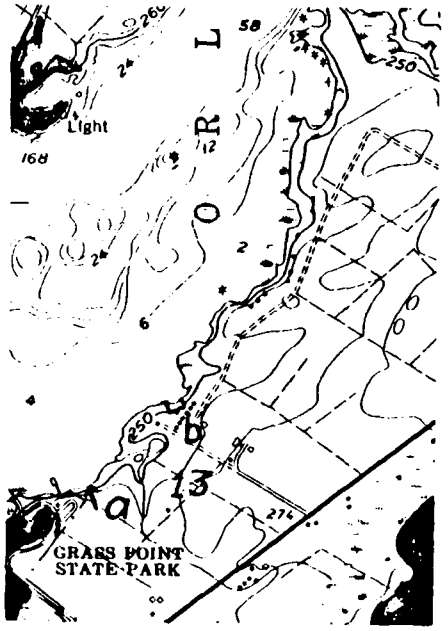




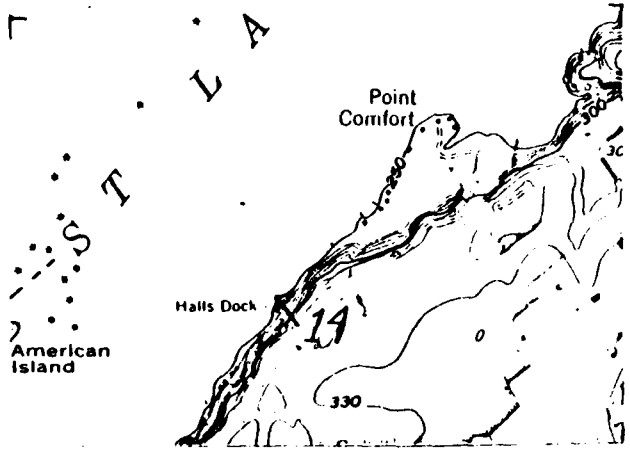
SLR sites 9, 10 and 11 (Clayton, N.Y., 1958).



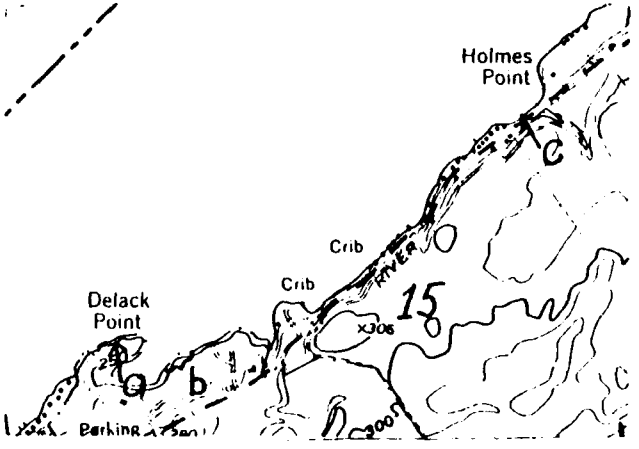
SLR site 12 (Clayton, N.Y., 1958).



SLR site 13 (Alexandria Bay, N.Y., 1958).

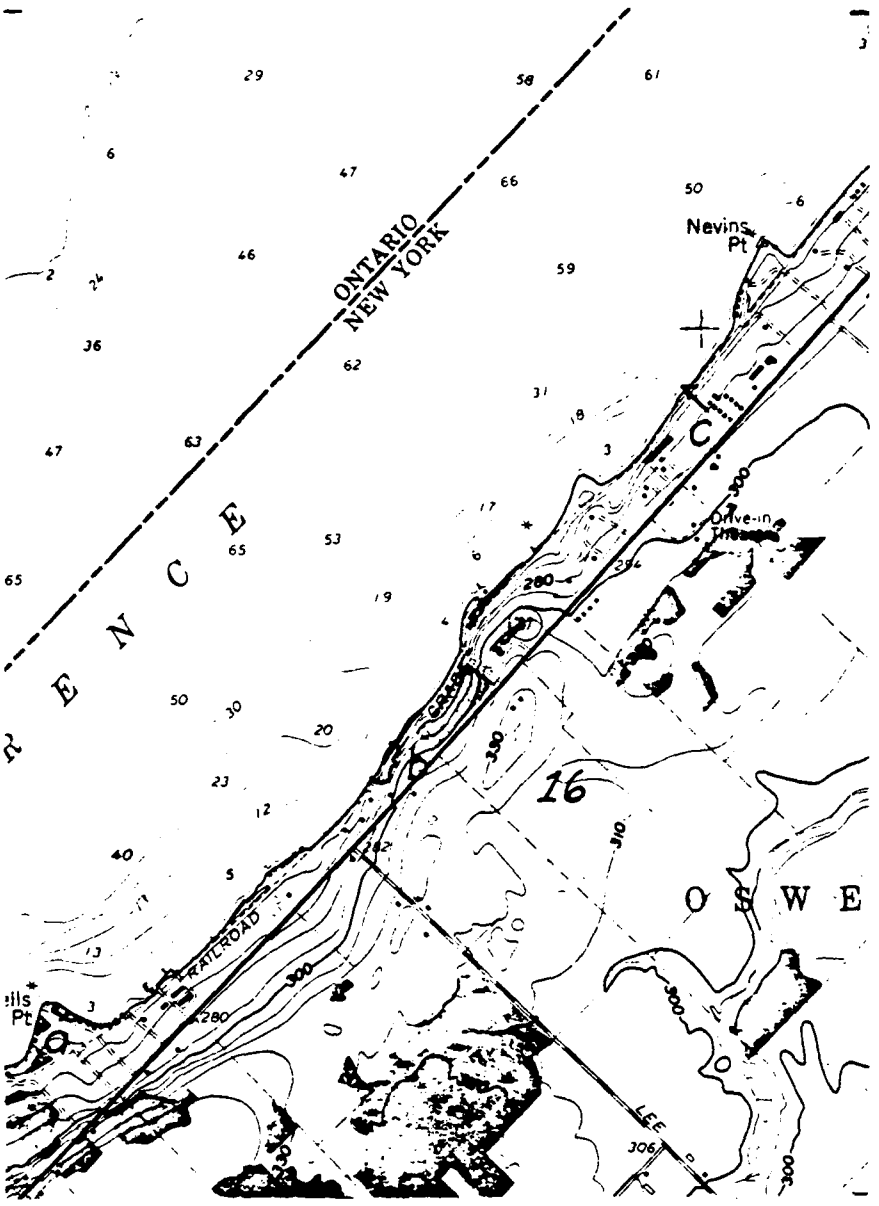


SLR site 14 (Morristown, N.Y., 1963).

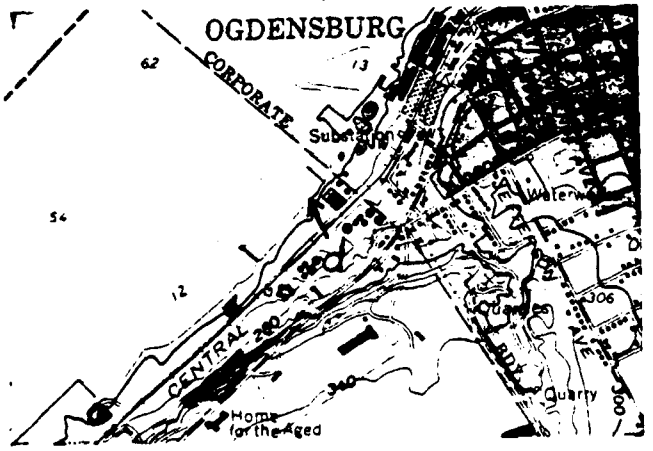


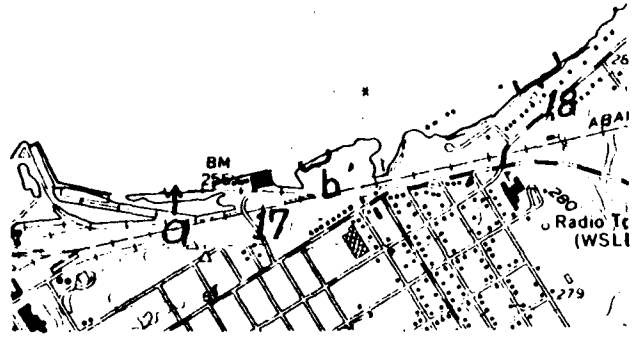
SLR site 15 (Morristown, N.Y., 1963).

801

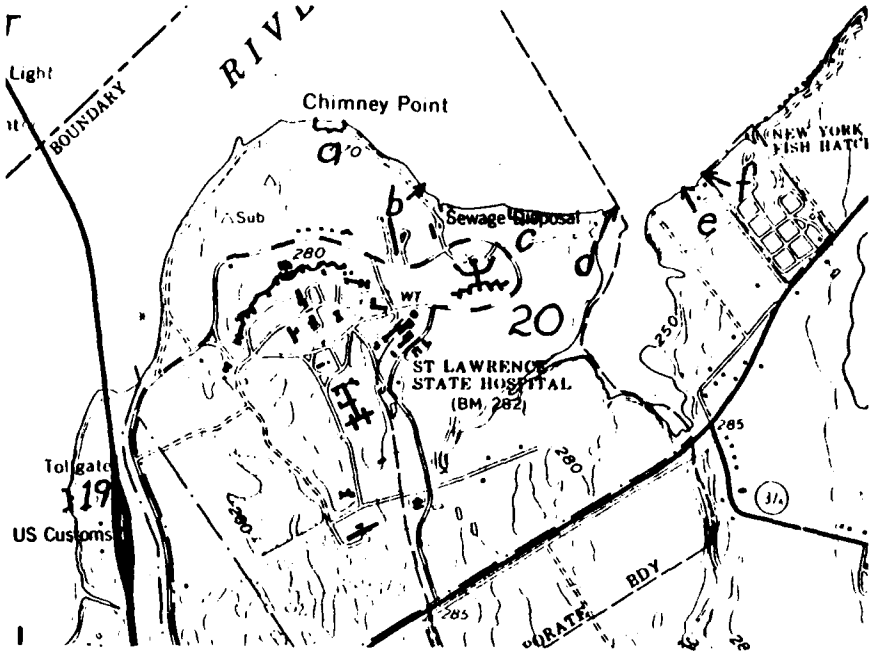


SLR site 16 (Ogdensburg West, N.Y., 1963).

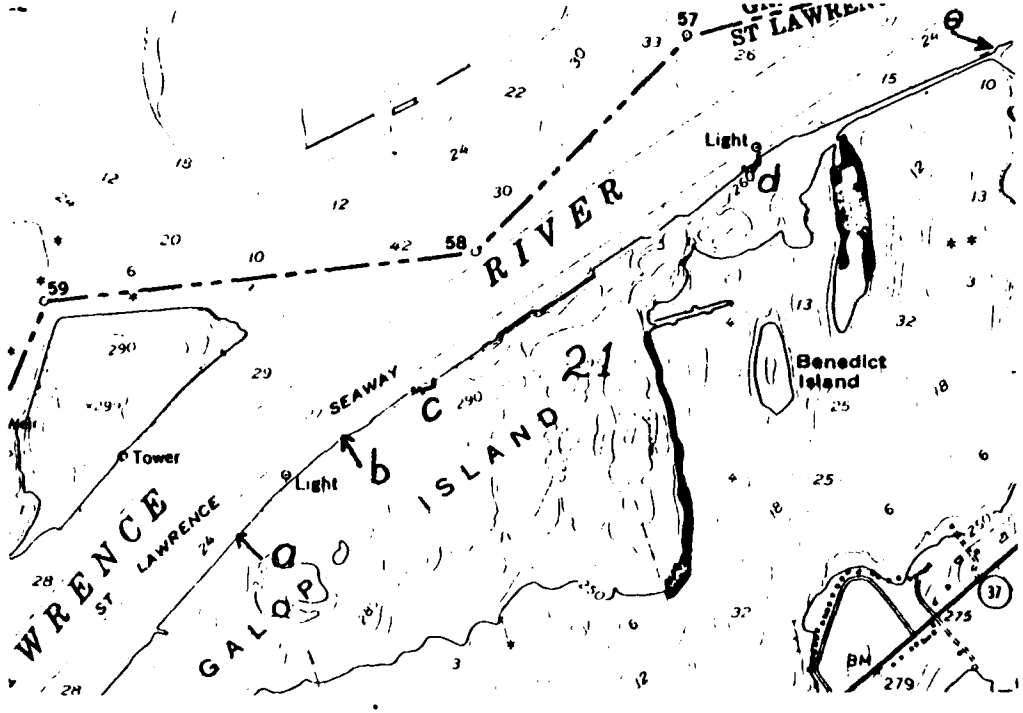




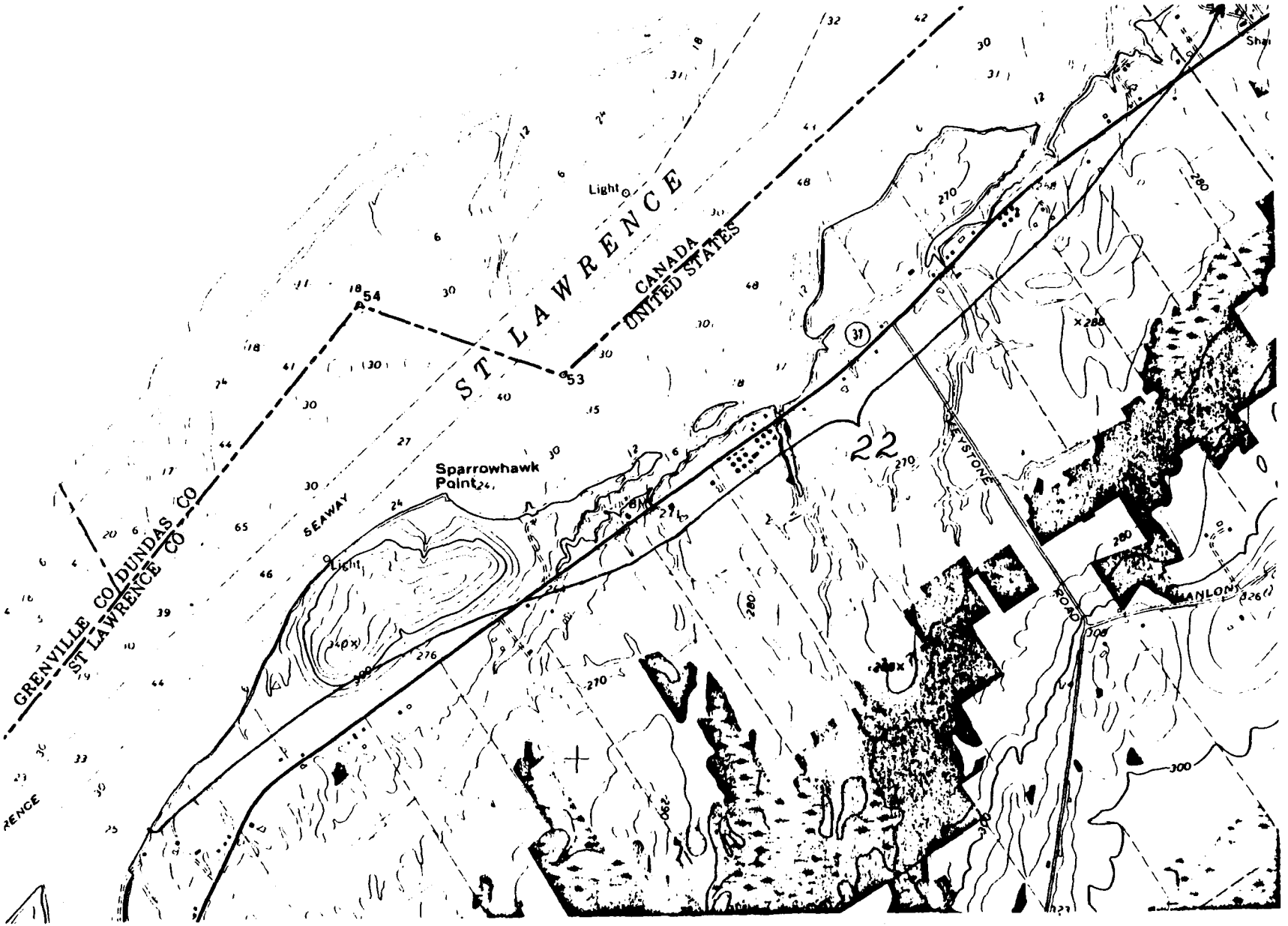
SLR sites 17 and 18 (Ogdensburg East, N.Y., 1963).



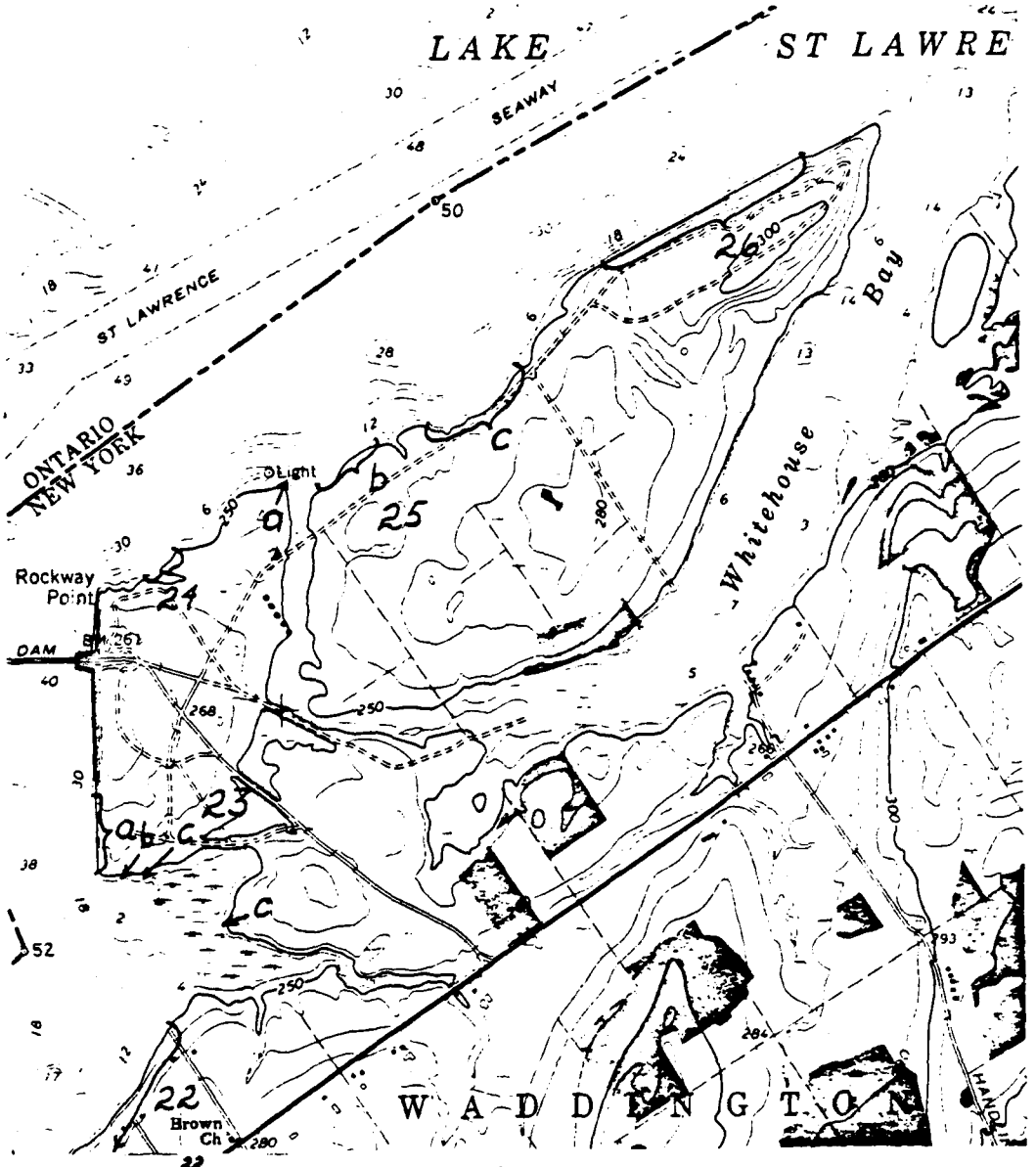
SLR sites 19 and 20 (Ogdensburg East, N.Y., 1963).



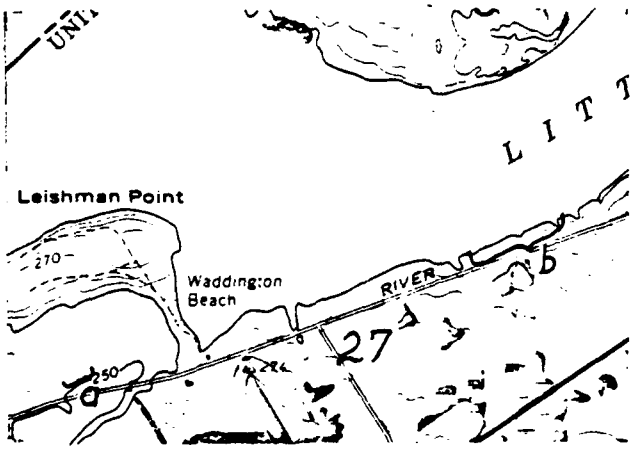
SLR site 21 (Red Mills, N.Y., 1963).



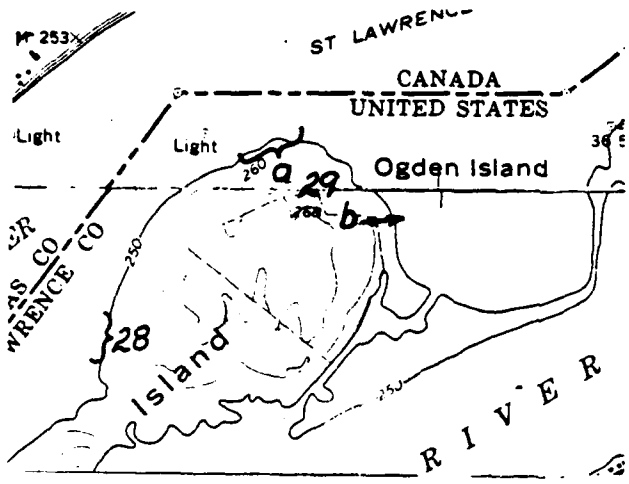
SLR site 22 (Sparrowhawk Point, N.Y., 1963).



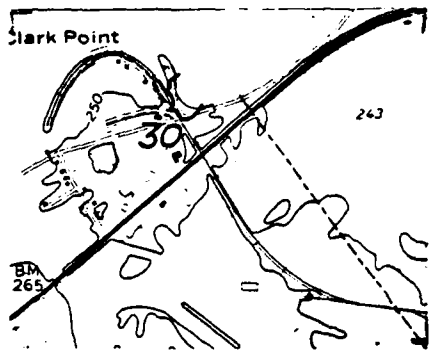
SLR sites 23, 24, 25 and 26 (Sparrowhawk Point, N.Y., 1963).



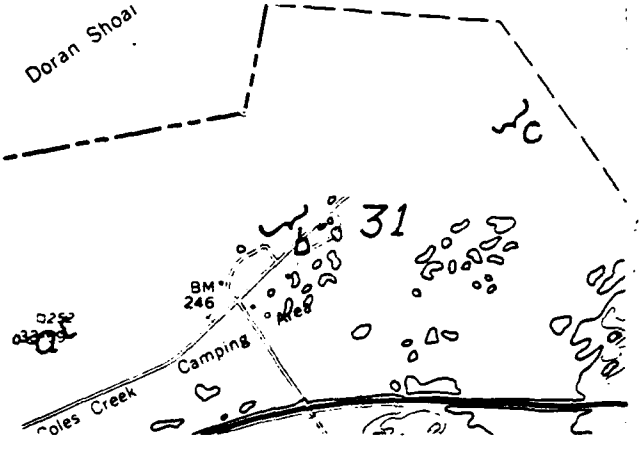
SLR site 27 (Waddington, N.Y., 1964).



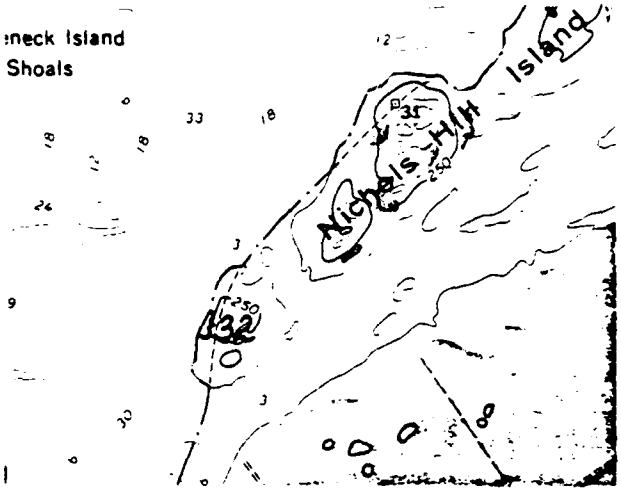
SLR sites 28 and 29 (Waddington, N.Y., 1964, and Morrisburg, Ont., 1964).



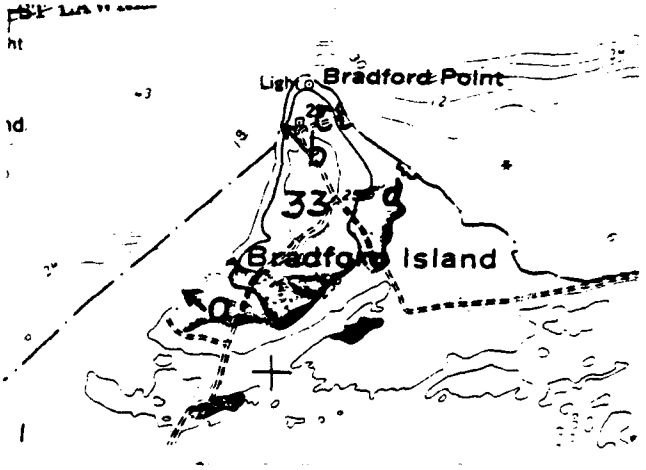
SLR site 30 (Waddington, N.Y., 1964).



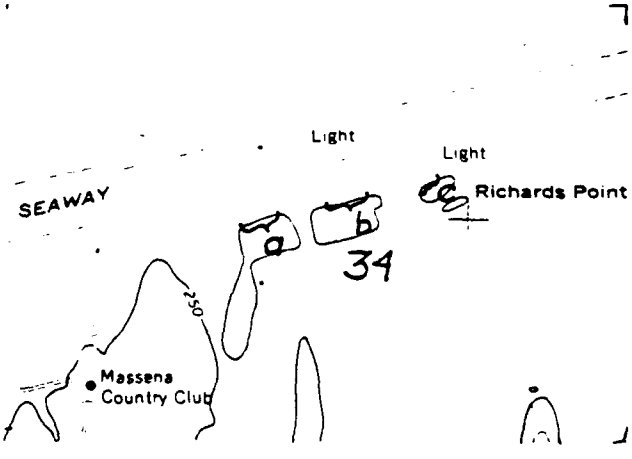
SLR site 31 (Morrisburg, Ont., 1964).



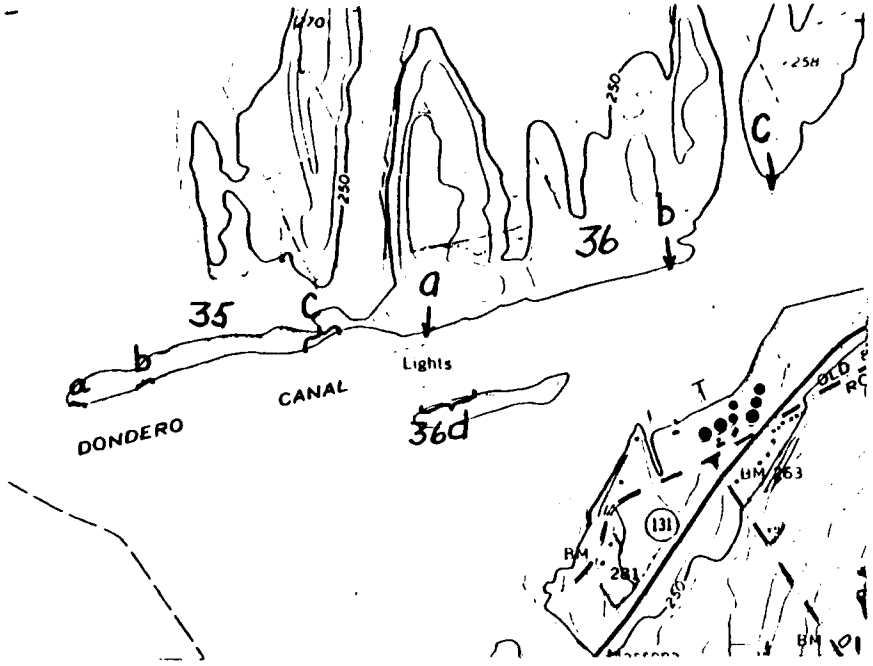
SLR site 32 (Louisville, N.Y., 1964).



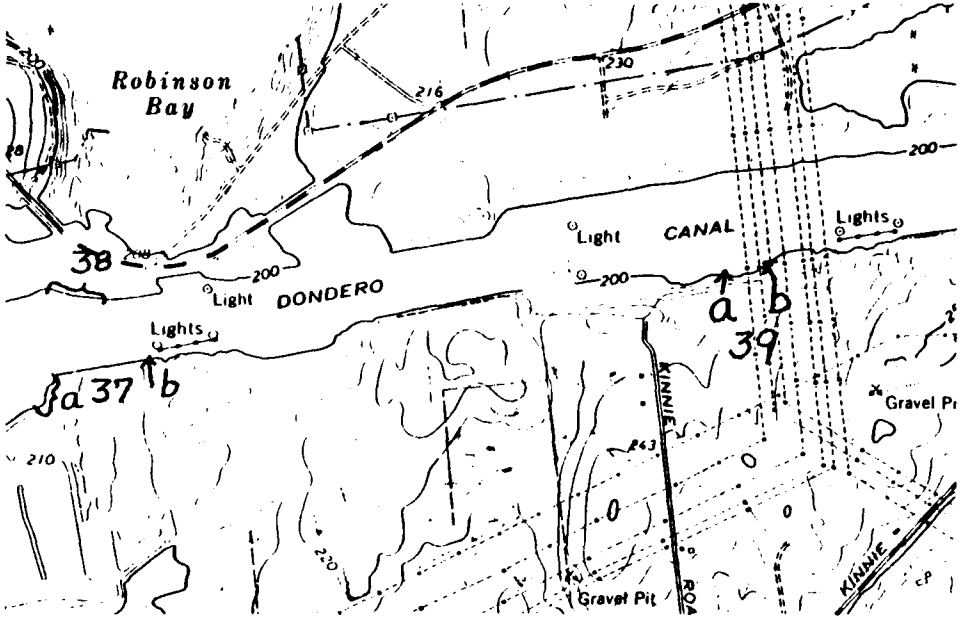
SLR site 33 (Lousiville, N.Y., 1964).



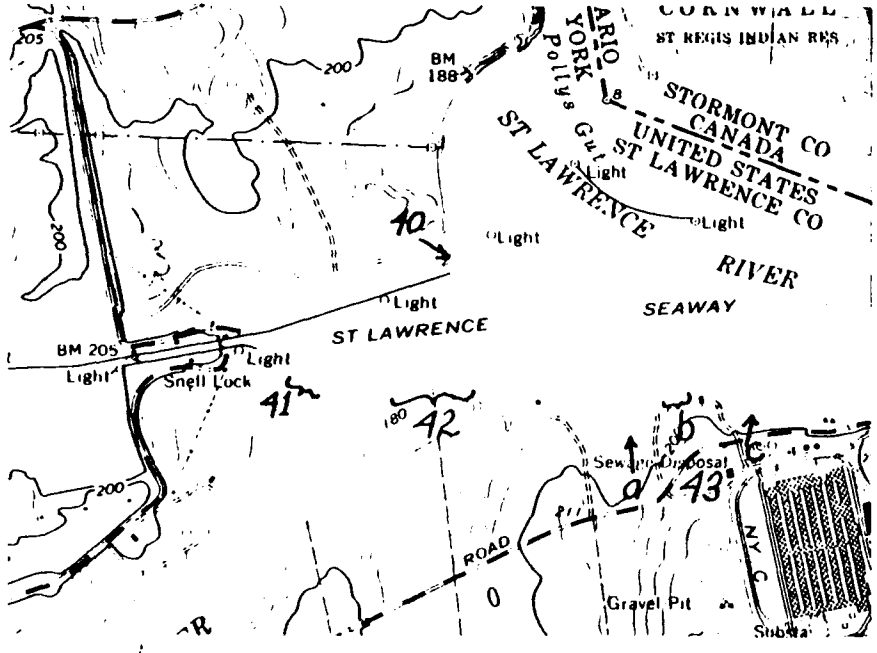
SLR site 34 (Massena, N.Y., 1964).



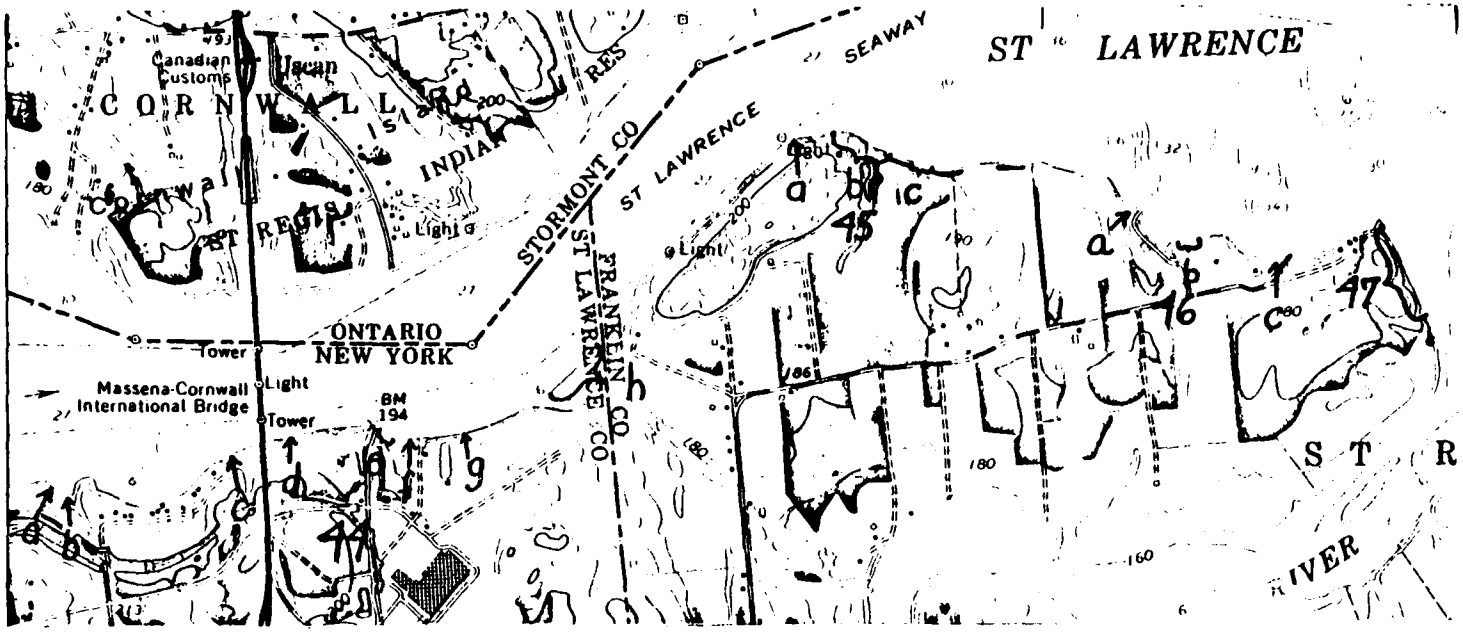
SLR sites 35 and 36 (Massena, N.Y., 1964).



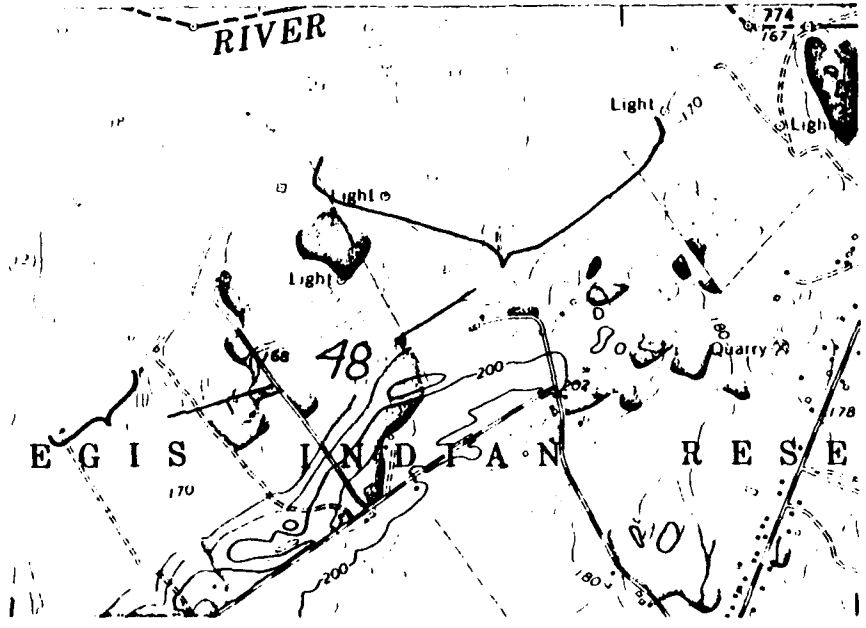
SLR sites 37, 38, and 39 (Raquette River, N.Y., 1964).



SLR sites 40, 41, 42 and 43 (Raquette River, N.Y., 1964).



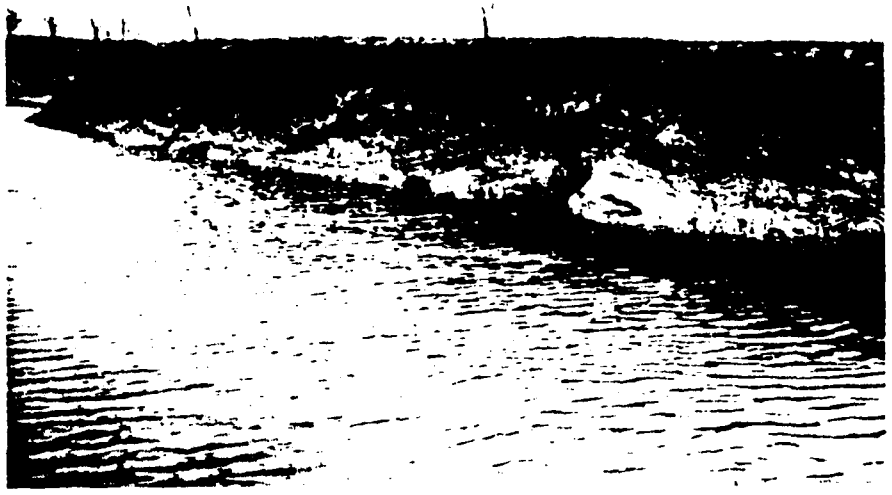
SLR sites 44, 45, 46 and 47 (Hogansburg, N.Y., 1964).



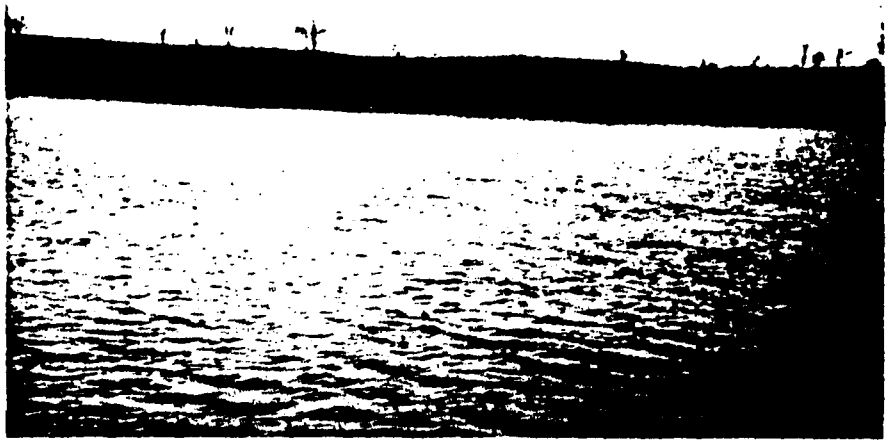
SLR site 48 (Hogansburg, N.Y., 1964).

St. Lawrence River

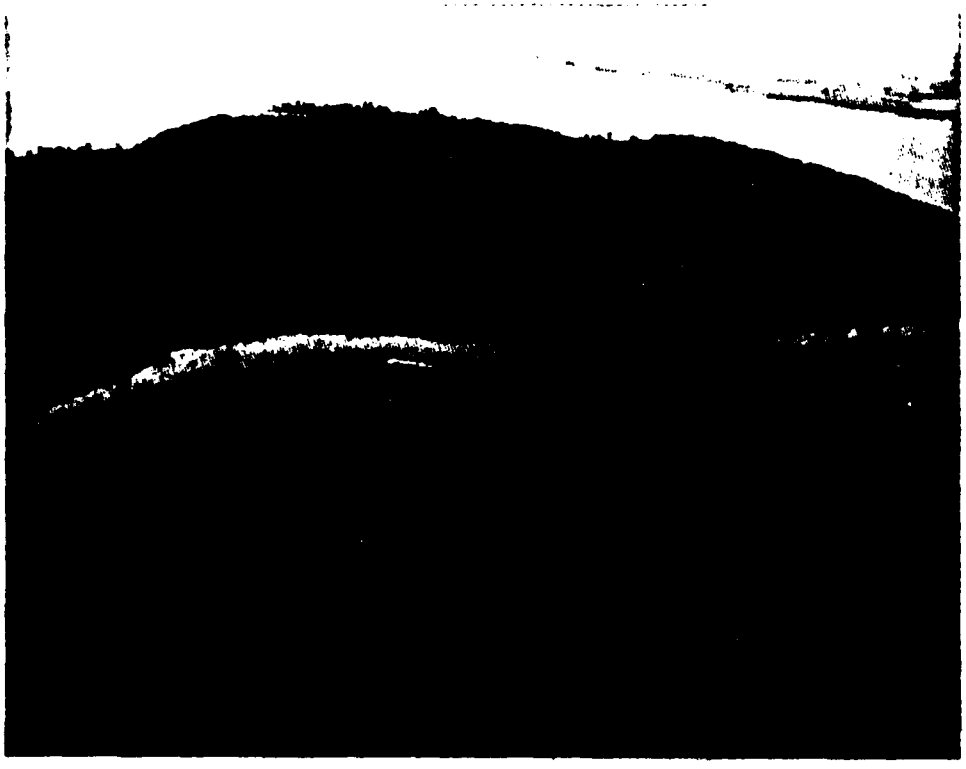
Selected photographs that illustrate the diversity of the eroding banks; not all eroding banks are shown.



SLR reach 6f, 18 May 78



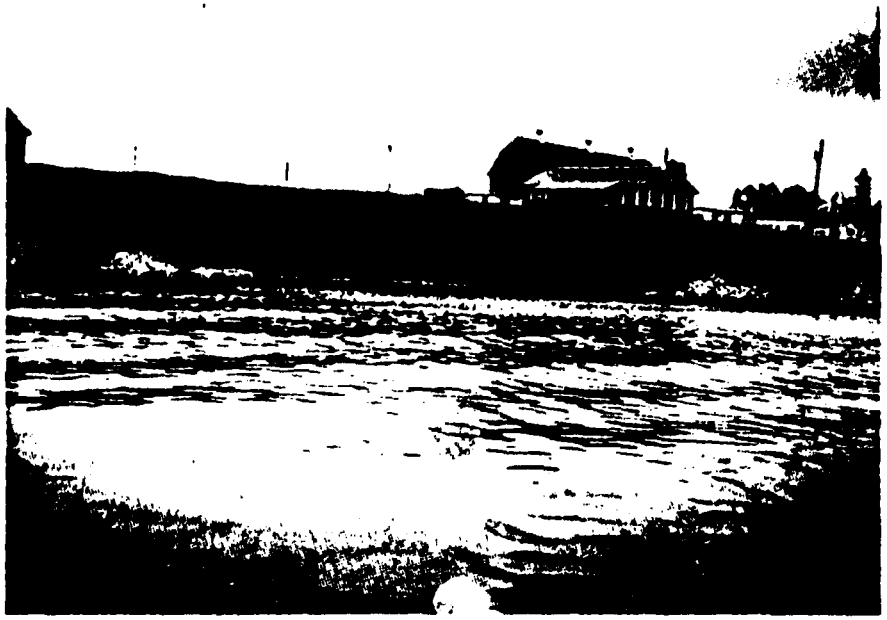
SLR reach 6f, 13 May 78



SLR reaches 6d-f

SLR reaches 6h-j

SLR site 12, 18 May 78

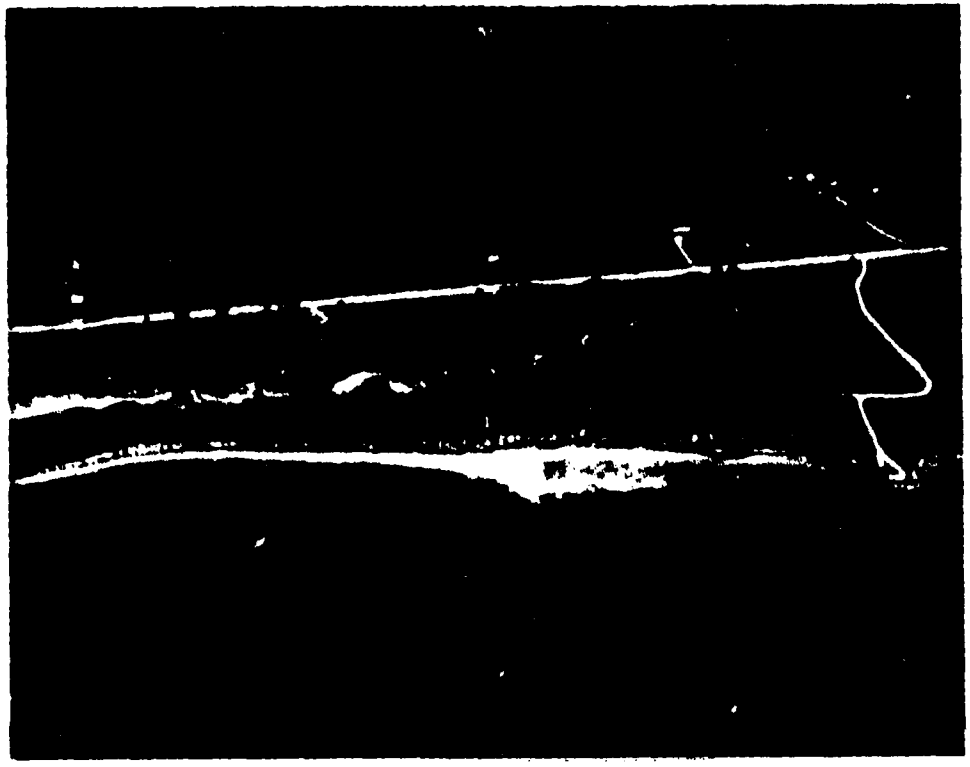


SLR site 12, 28 May 78

SLR reach 20e, 16 Nov 77

SLR reach 20f, 28 May 78

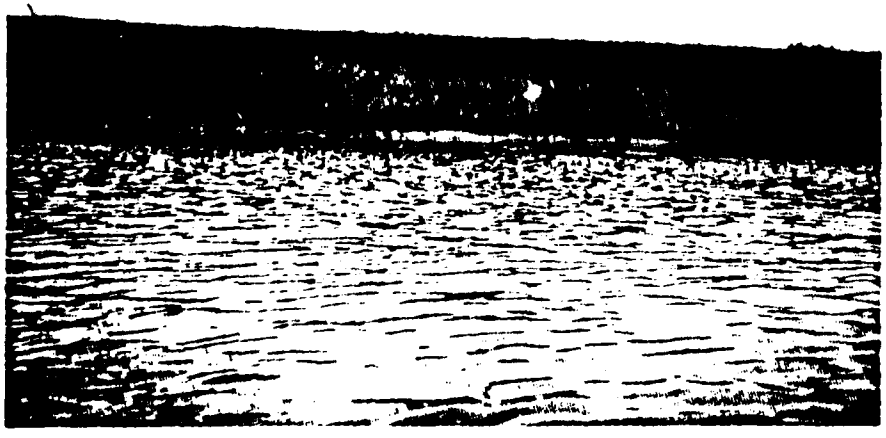
8//



SLR site 22

611

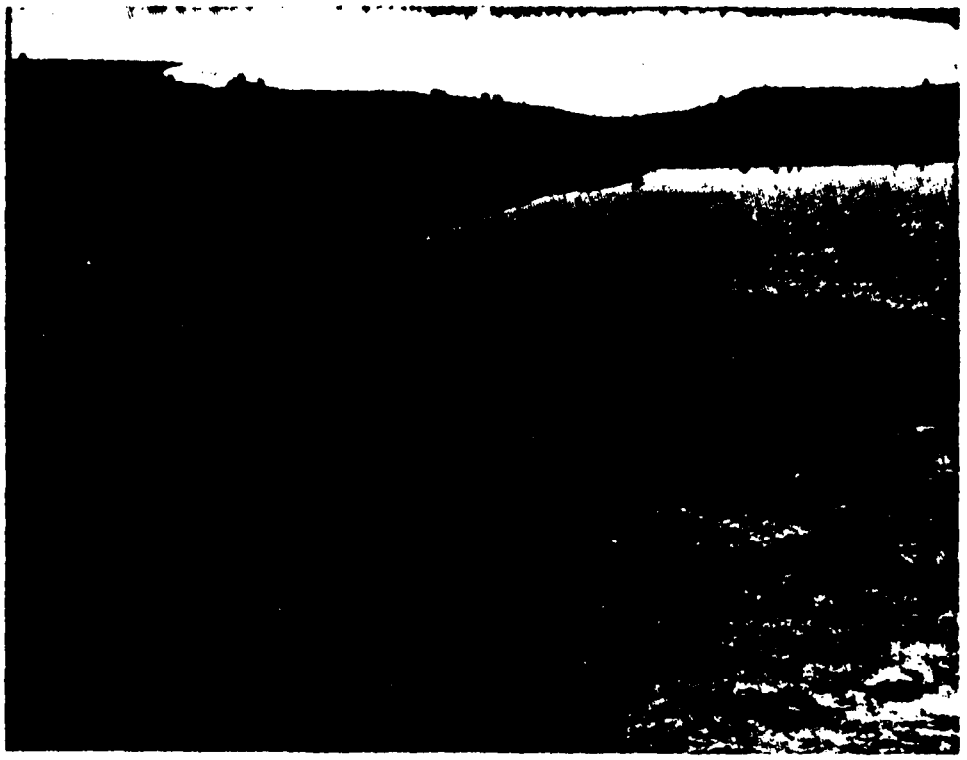
SLR site 22, 17 May 78



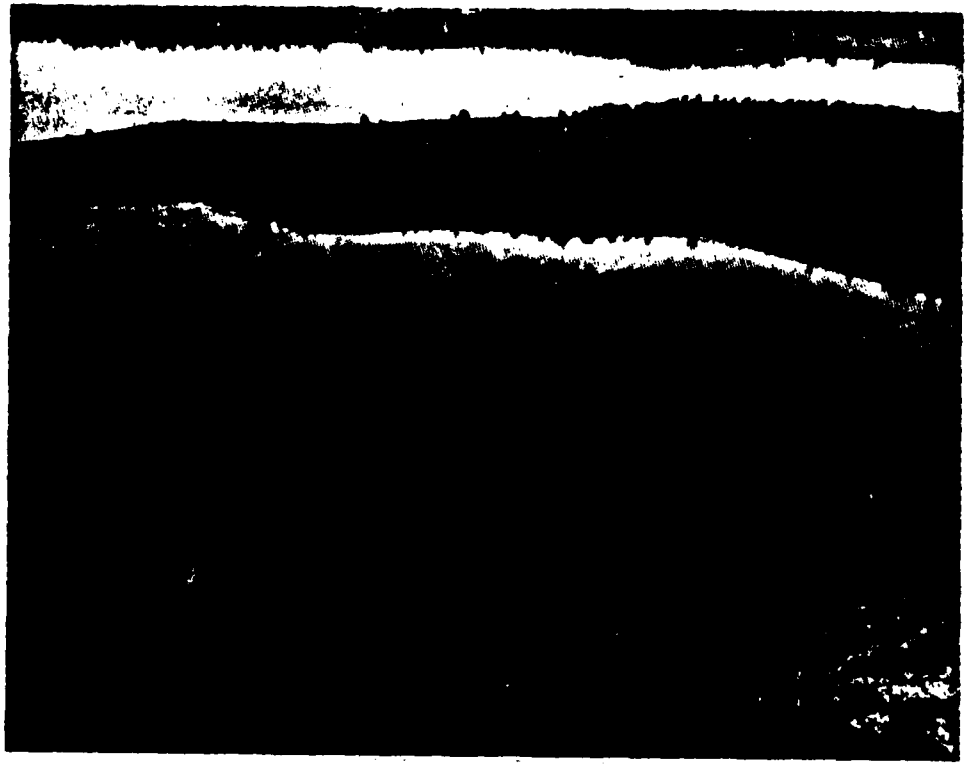
SLR site 22, 17 May 78

SLR reach 25c, 28 Oct 78

SLR site 26, 17 May 78



SLR site 28



SLR site 28

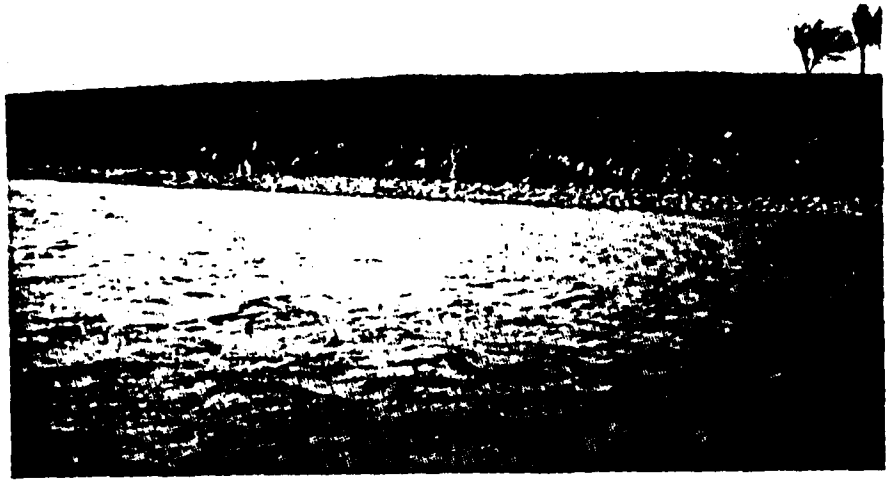
SLR reach 31a, 27 Oct 78

SLR reach 34a, 27 Oct 78

SLR reach 34b, 27 Oct 78

SLR reach 35c, 18 May 78

SLR reach 36a, 27 Oct 78



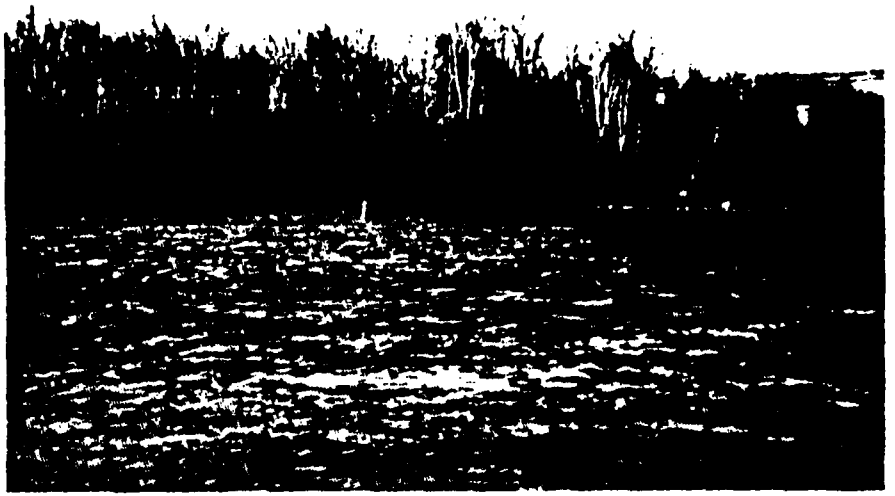
SLR reach 36b, 27 Oct 78

SLR site 41, 16 May 78

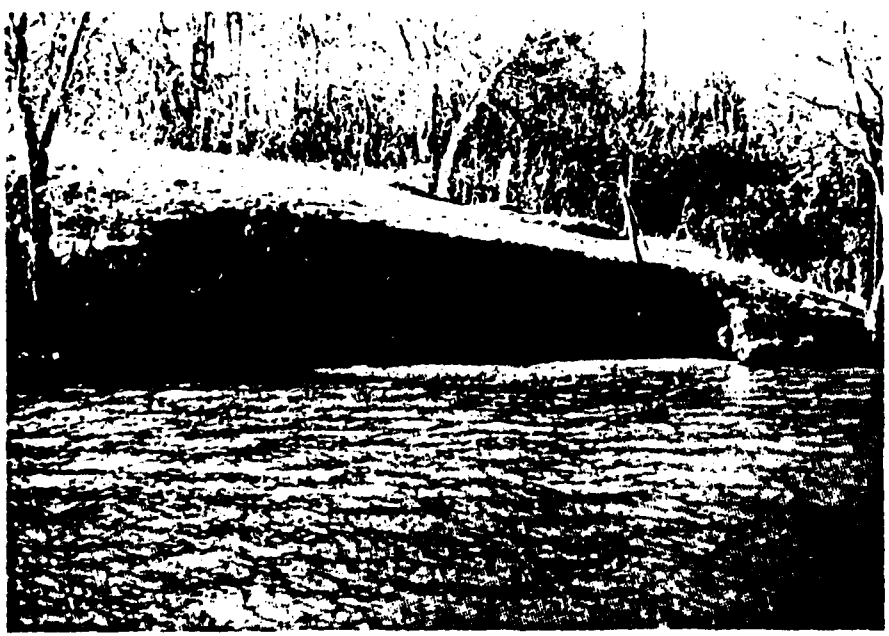
SLR site 41, 17 Nov 77

SLR site 42, 16 May 78

SLR site 42, 16 May 78



SLR reach 44d, 27 Oct 78



SLR reach 45b, 27 Oct 78

SLR site 47, 27 Oct 78

SLR site 48, 17 Nov 77

St. Lawrence River

Descriptions, photographs and generalized river cross-sections for profiled reaches, some eroding reaches and selected sites (distances in feet).

SITE NO. SLR 20a DATE _____ Weather:

Sample taken ☐ Yes ☐ No

SLR 20a

BEACH Photo No.____	☐ Yes ☐ No	Orientation E-W	Width 0-5	Texture Sandy gravel, scattered cobbles and boulders (Fig. D60)	Remarks

BLUFF Photo No.____	Orientation E-W	Height .5-2	Slope 45°-90°	Length 300	Evidence of Surface Runoff ☒ No Rills Gullies	Evidence of Groundwater Seepage ☒ No Staining Damp Zone Vegetation Other	Remarks No distinct bluff (Fig. D61)	
	Vegetation Collapsing Stable Type X Grass	Remarks						

SOIL	☐ Artificial (fill) ☒ Natural	Texture Gravelly sand	Color Tan	Structures Not observable	Remarks

NEARSHORE CONDITIONS	Bathymetry Shelf Steep Shelf/Drop off X (Fig. D71)	Texture Gravel, cobbles, boulders	Bedforms ☐ No	Vegetation ☒ No Type Density	Remarks High water velocities	

LANDUSE	Residential Sparse ☐ Medium ☐ Dense ☐	Commercial Sparse ☐ Medium ☐ Dense ☐ X	Agricultural	Recreational	None	Remarks State Hospital property

UPSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Cab Other	Vegetated Bluff X	Slope	Nearshore Conditions Similar	Remarks
DOWNSTREAM CONDITIONS Photo No.____	Protective Structures B.H. RR Cab Other	Vegetated Bluff X	Slope	Nearshore Conditions Similar	Remarks

REMARKS

SITE NO. SLR 26 DATE _____ Weather:

Sample taken ☒ Yes ☐ No

SLR 26

BEACH Photo No. ____	☒ Yes ☐ No	Orientation NE-SW	Width 0-15	Texture Gravel, cobbles, and boulders (Fig. D62)	Remarks							
BLUFF Photo No. ____	Orientation NE-SW	Height 1-10	Slope 45°-70	Length 2400	Evidence of Surface Runoff ☒ No Rills: X Gullies: X	Evidence of Groundwater Seepage X☒ No Staining	Damp Zone	Vegetation	Other	Remarks Rills and gullies especially on the west end of site		
	Vegetation Collapsing:	Stable X (Fig. D63)	Type Grass	Remarks The fact of the bluff has more vegetation on the west end of the site; cows graze and climb up and down banks causing some erosion								
SOIL	☒ Artificial (fill) ☒ Natural	Texture Silty sand with gravel and cobbles	Color Dark brown upper and lt. brown lower	Structures Layered	Remarks Lower part of soil horizon is a grey-brown, silty clay till							
NEARSHORE CONDITIONS	Bathymetry Shelf:	Steep (Fig. D73)	Shelf/Drop off X	Texture Gravel, cobbles and boulders	Bedforms ☒ No XX	Vegetation ☒ No Type: XX	Density	Remarks				
LANDUSE	Residential Sparse ☐	Medium ☐	Dense ☐	Commercial Sparse ☐	Medium ☐	Dense ☐	Agricultural X	Recreational	None	Remarks		
UPSTREAM CONDITIONS Photo No.	Protective Structures B.H.	RR	Gab	Other	Vegetated Bluff X	Slope	Nearshore Conditions Similar	Remarks				
DOWNSTREAM CONDITIONS Photo No. ____	Protective Structures B.H.	RR	Gab	Other	Vegetated Bluff X	Slope	Nearshore Conditions Similar	Remarks				

REMARKS

SITE NO. SLR 31b DATE _____ Weather:

Sample taken ☐ Yes ☐ No

SLR 31b

BEACH Photo No. _____	☒ Yes ☐ No	Orientation NE-SW	Width 0-15	Texture Fine sand (Fig. D64)	Remarks					
BLUFF Photo No. _____	Orientation NE-SW	Height 1-3	Slope 45°-90°	Length 500	Evidence of Surface Runoff ☒ No Rills Gullies	Evidence of Groundwater Seepage ☒ No Staining Damp Zone Vegetation Other			Remarks In many places, no distinct bluff (Fig. D64)	
	Vegetation Collapsing Stable Type X Grass	Remarks Clumps of grass collapse after water undercuts the soil (Fig. D65)								
SOIL	☐ Artificial (fill) ☒ Natural	Texture Sand	Color Tan	Structures Layered	Remarks					
NEARSHORE CONDITIONS	Bathymetry Shelf Steep Shelf/Drop off (Fig. D74) X	Texture Sand	Bedforms ☐ No Ripples	Vegetation ☒ No Type Density	Remarks					
LANDUSE	Residential Sparse ☐ Medium ☐ Dense ☐	Commercial Sparse ☐ Medium ☐ Dense ☐	Agricultural	Recreational Park	None	Remarks Coles Creek State Park				
UPSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Gab Other X	Vegetated Bluff	Slope Grass	Nearshore Conditions Similar	Remarks					
DOWNSTREAM CONDITIONS Photo No. _____	Protective Structures B.H. RR Gab Other X	Vegetated Bluff	Slope Grass	Nearshore Conditions Similar	Remarks					

REMARKS

SITE NO. SLR 38 DATE _____ Weather:

Sample taken ☐ Yes ☐ No

SLR 38

BEACH Photo No. ____	☐ Yes ☐ No	Orientation E-W	Width 0-10	Texture Gravelly sand with cobbles (Fig. D66)	Remarks			
BLUFF Photo No. ____	Orientation E-W	Height 3-6	Slope 45°-90°	Length 600	Evidence of Surface Runoff ☒ No Rills Gullies	Evidence of Groundwater Seepage ☒ No Staining Damp Zone Vegetation Other	Remarks	
	Vegetation Collapsing Stable Type X Grass	Remarks Grass clumps along face and at toe of bluff (Figs. D66 and D67)						
SOIL	☐ Artificial (fill) ☒ Natural	Texture Silt or clay	Color Brown to grey	Structures Clay is layered (Fig. D68)	Remarks Clay appears to "flow" out onto beach (Fig. D69)			
NEARSHORE CONDITIONS	Bathymetry Shelf Steep Shelf/Drop off (Fig. D76) X	Texture Gravel and cobbles	Bedforms ☒ No	Vegetation X ☐ No Type Density	Remarks			
LANDUSE	Residential Sparse ☐ Medium ☐ Dense ☐	Commercial Sparse ☐ Medium ☐ Dense ☐	Agricultural	Recreational Park	None	Remarks Robert Moses State Park		
UPSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Gab Other	Vegetated Bluff X	Slope	Nearshore Conditions Similar	Remarks Grass plain in backshore			
DOWNSTREAM CONDITIONS Photo No.	Protective Structures B.H. RR Gab Other	Vegetated Bluff X	Slope	Nearshore Conditions Similar	Remarks Grass-covered bluff looks stable; grassy plain in backshore			

REMARKS

Figure D60. SLR reach 20a, 23 Oct 78.

Figure D61. SLR reach 20a, 18 May 78.

Figure D62. SLR reach 26, 17 May 78.

Figure D63. SLR reach 26, 17 May 78.

Figure D64. SLR reach 31b, 17 May 78.

Figure D65. SLR reach 31b, 2 Oct 79.

Figure D66. SLR reach 38, 16 May 78.

Figure D67. SLR reach 38, 1 Oct 79.

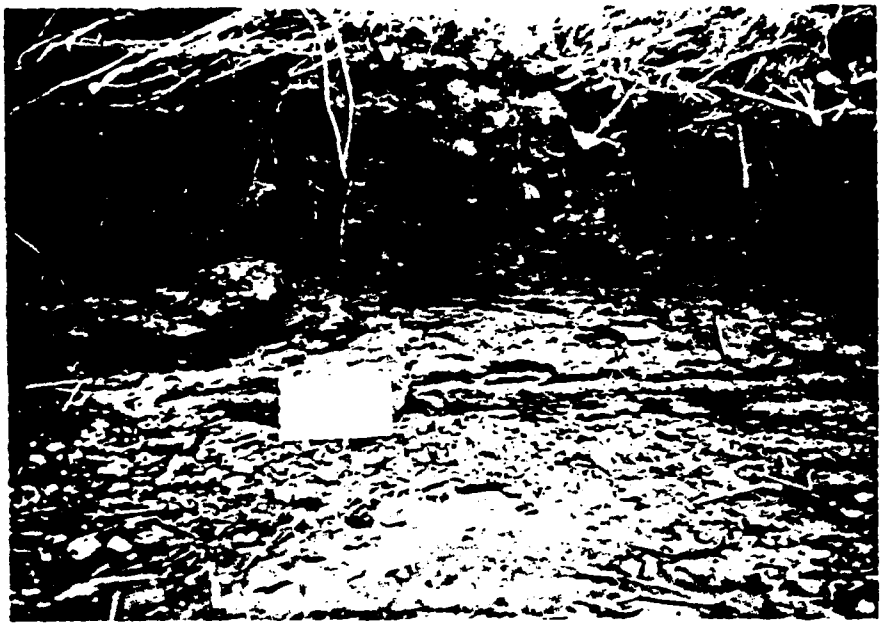


Figure D68. SLR reach 38, 1 Oct 79.

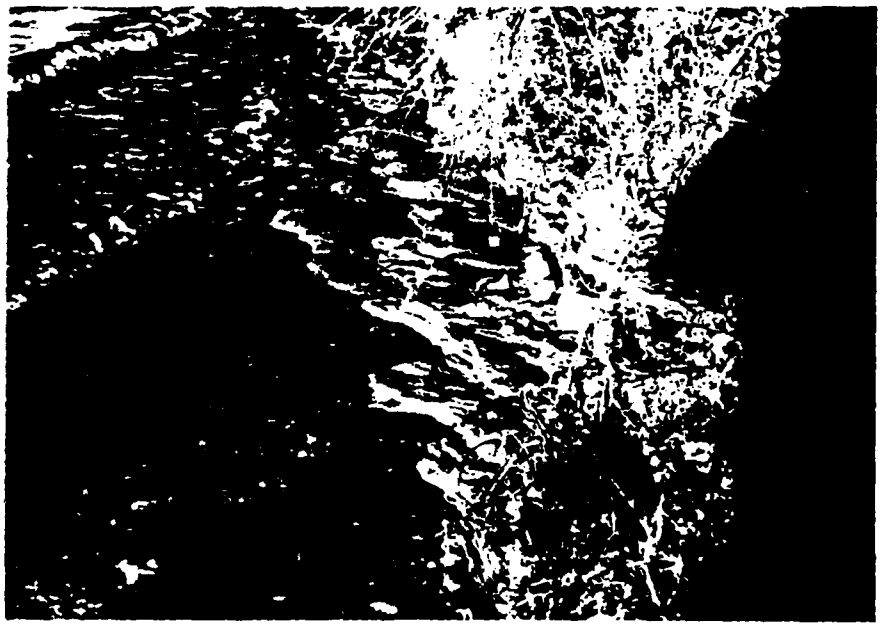
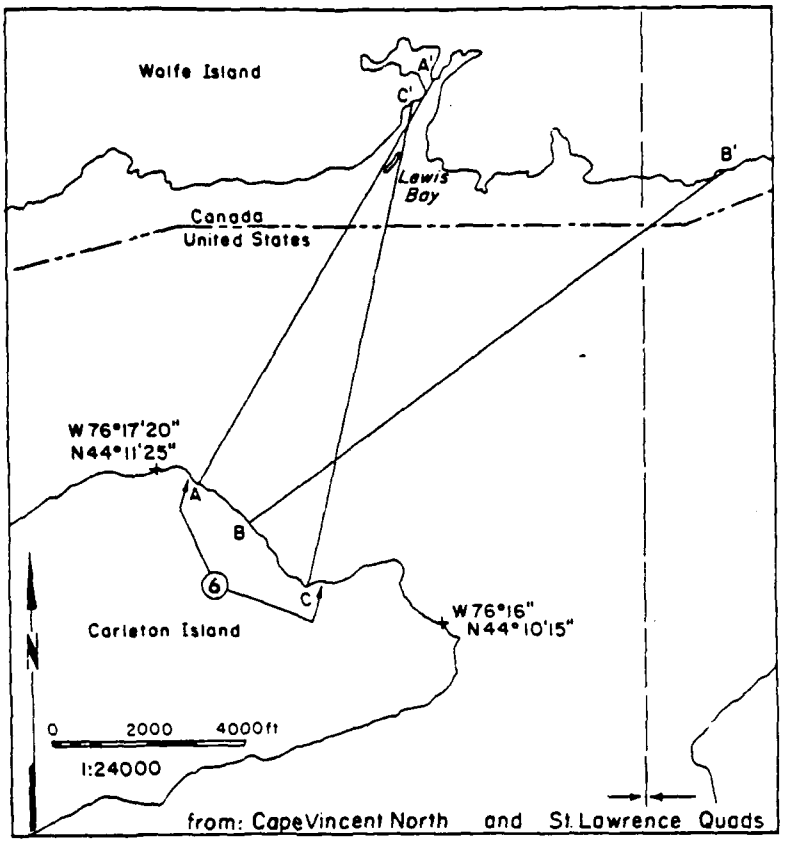


Figure D69. SLR reach 38, 27 Oct 78.



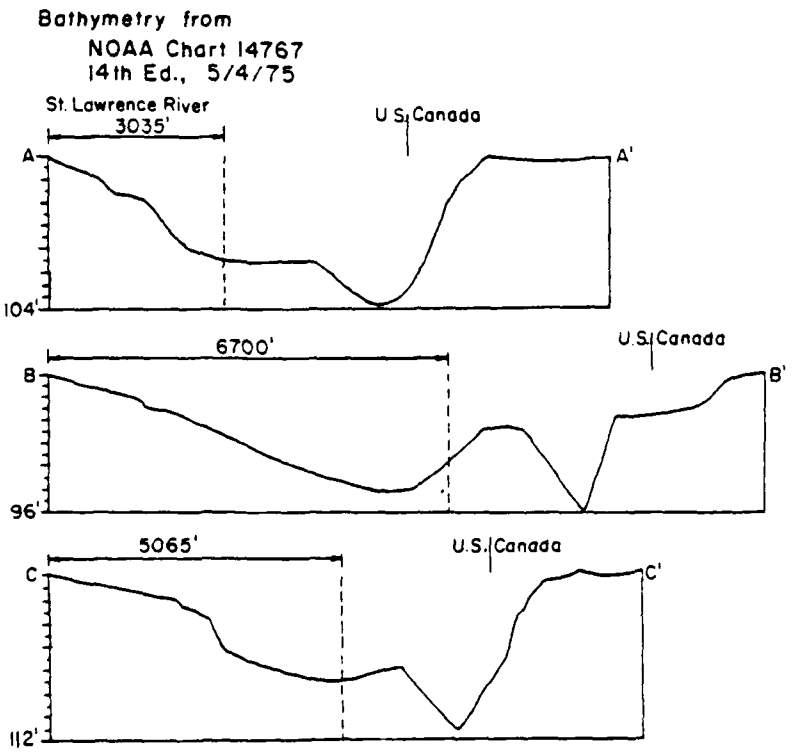
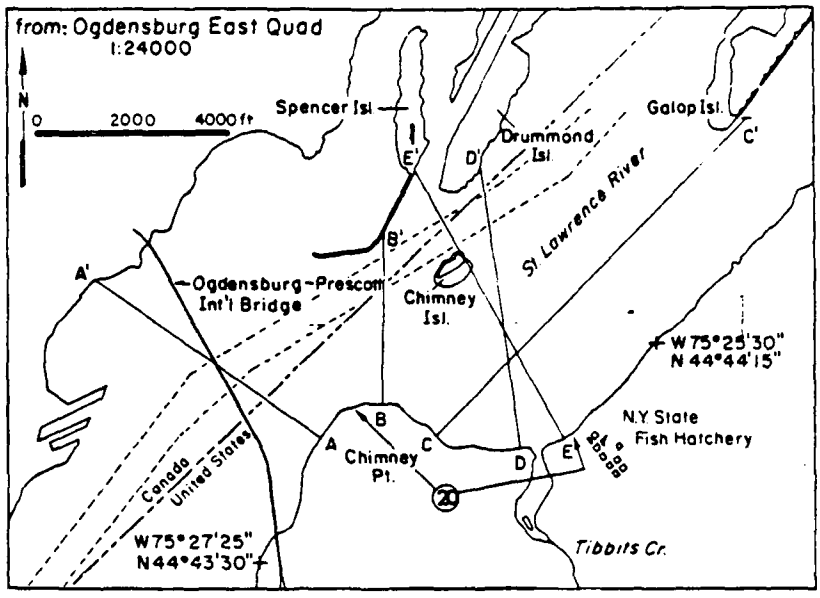
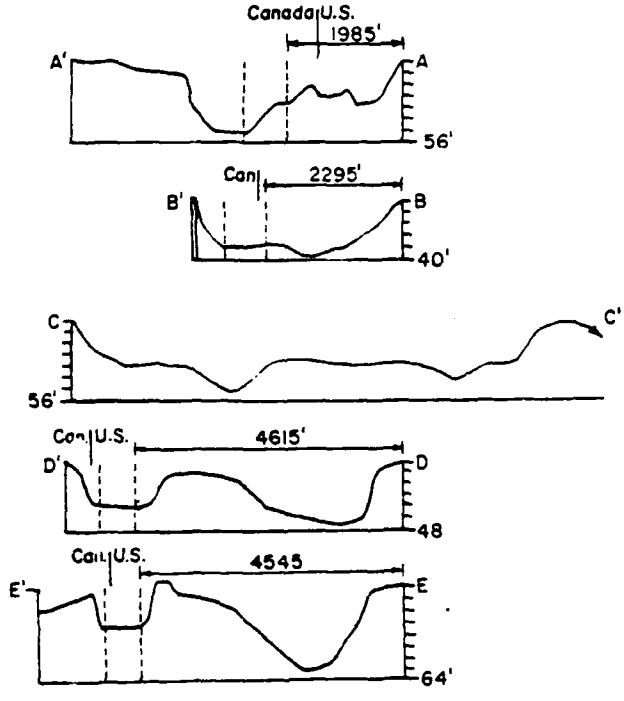


Figure D70. Generalized river cross-sections, site 6, St. Lawrence River.

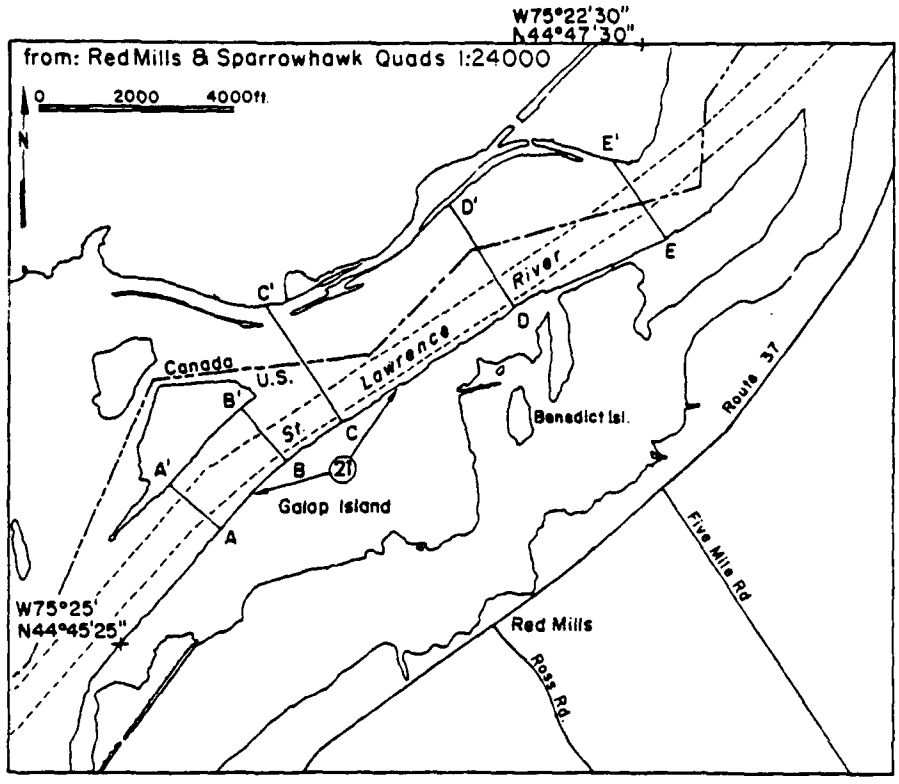


Bathymetry from NOAA Chart #14763
26th Ed., 5/11/77



(Vert. Exag. 1:25)

Figure D71. Generalized river cross-sections, site 20, St. Lawrence River.



Bathymetry from NOAA Chart #14763
26th Ed., 5/11/77

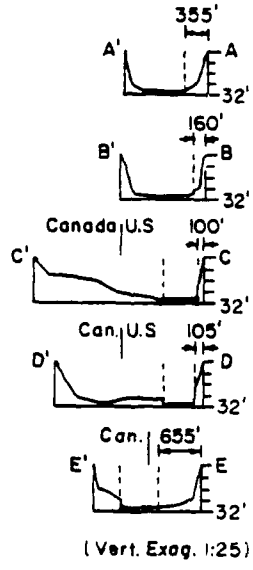


Figure D72. Generalized river cross-sections, site 21, St. Lawrence River.

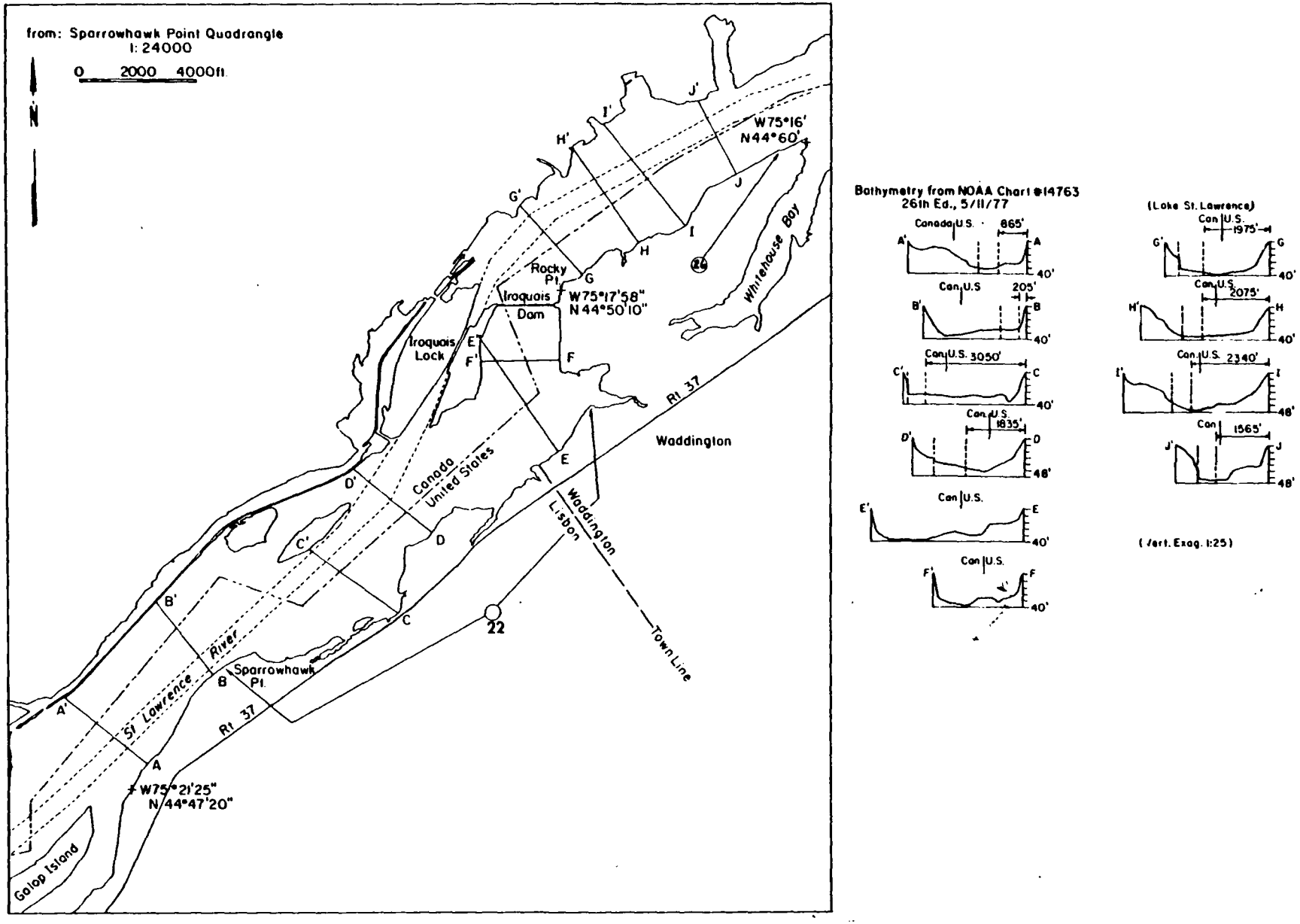
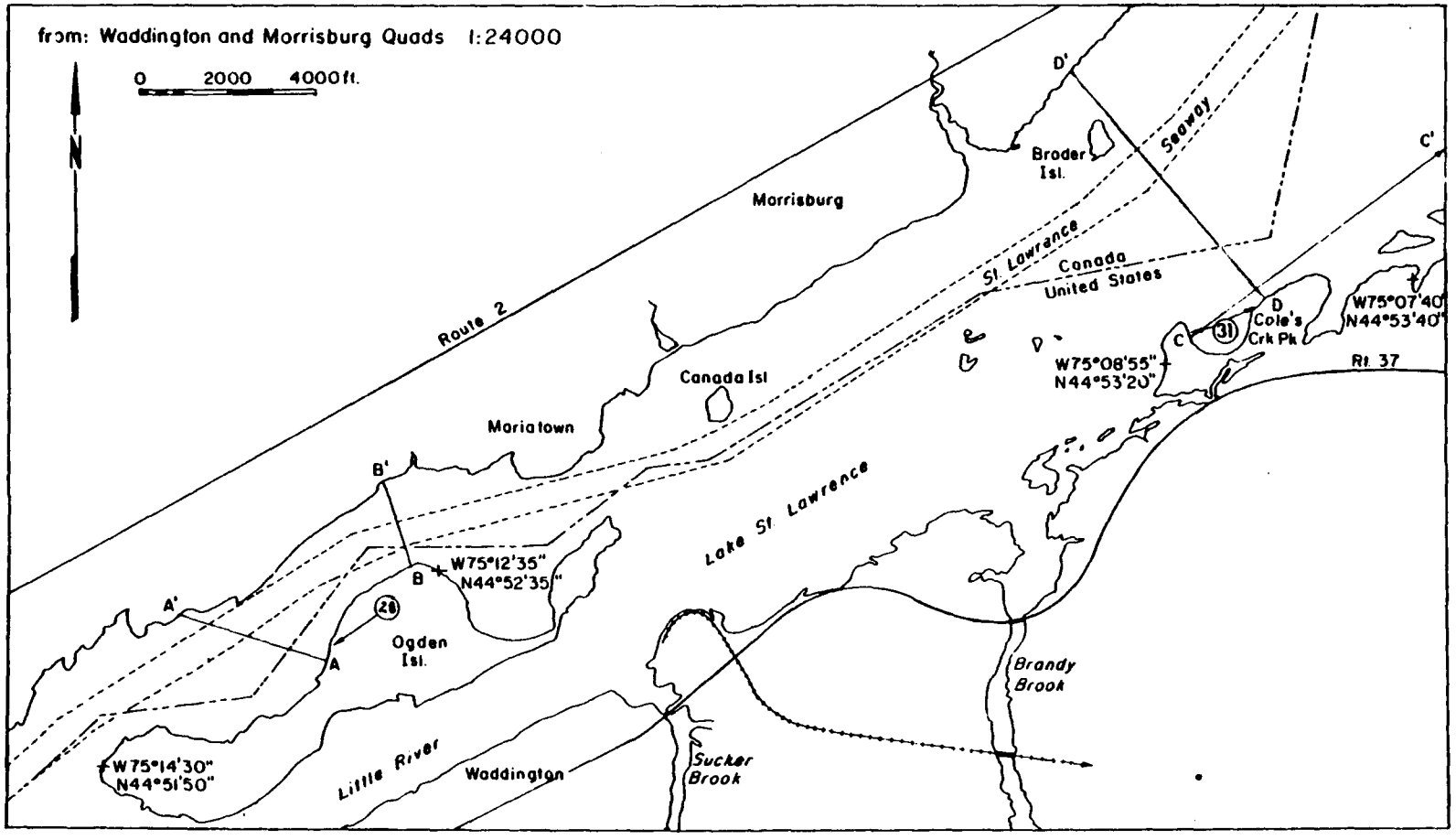


Figure D73. Generalized river cross-sections, sites 22 to 26, St. Lawrence River.



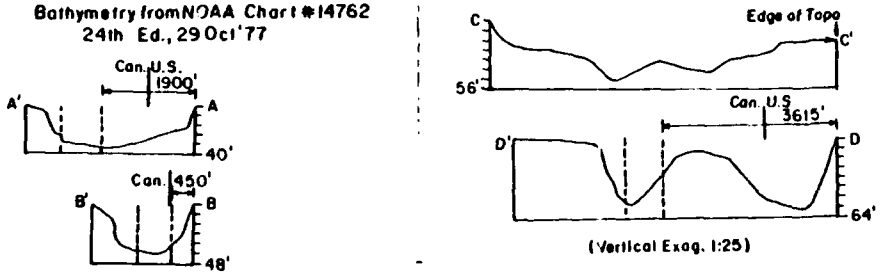
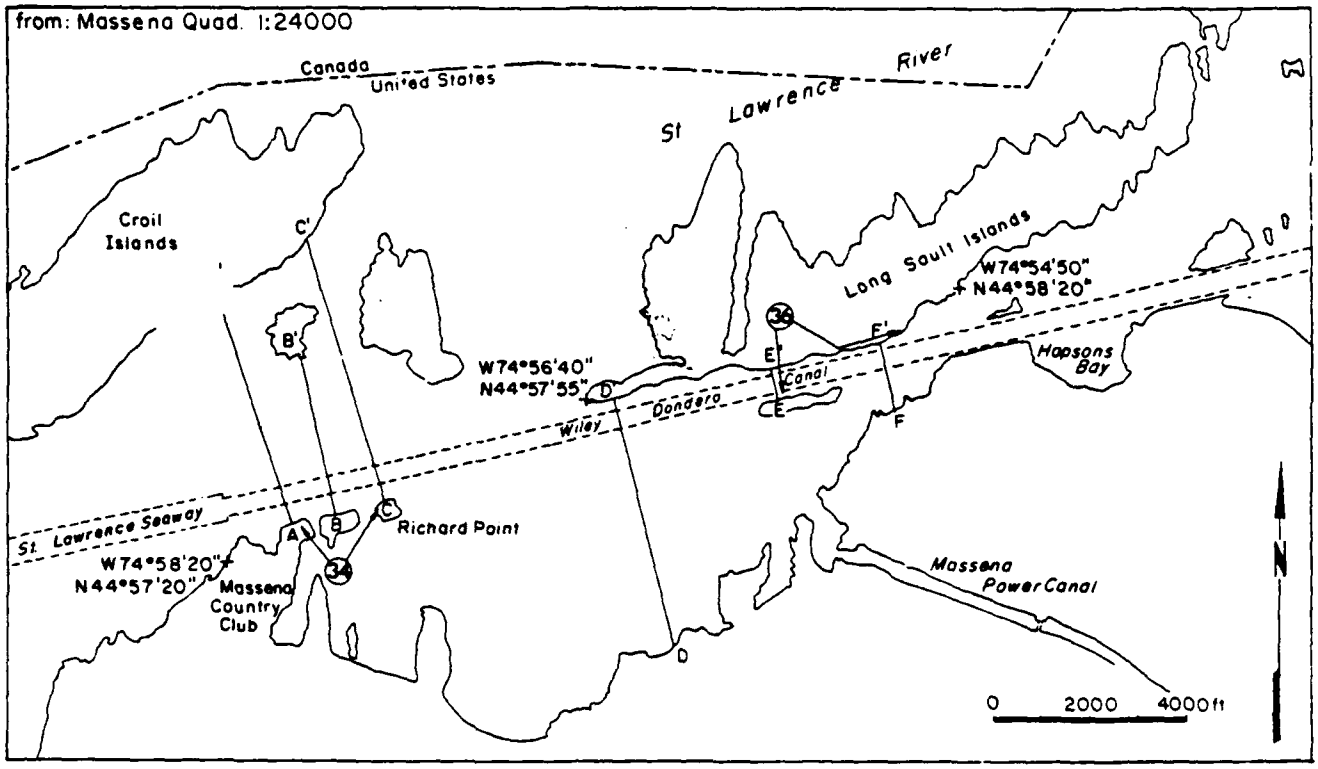
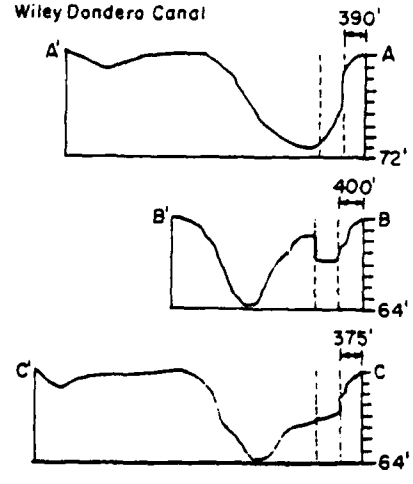


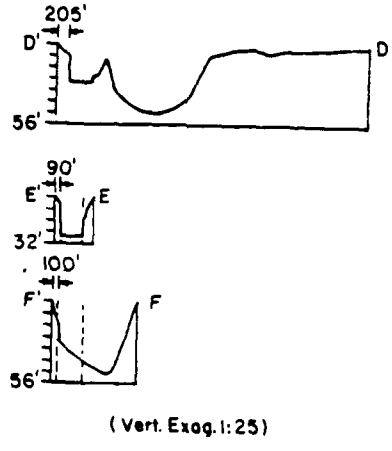
Figure D74. Generalized river cross-sections, sites 28 to 31, St.



Bathymetry from NOAA Chart #14762
24th Ed., 29/10/77

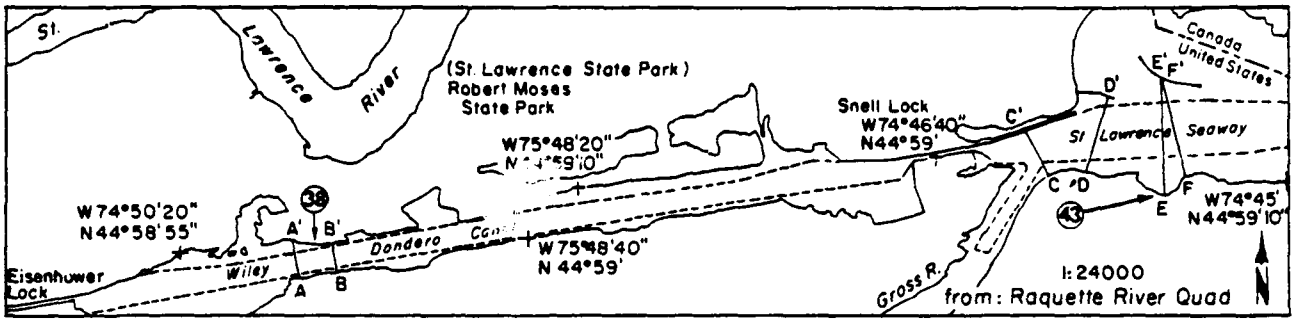


Bathymetry from NOAA Chart #14761
25th Ed., 24/9/77



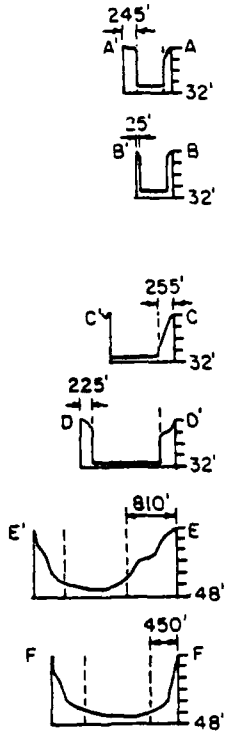
(Vert. Exag. 1:25)

Figure D75. Generalized river cross-sections, sites 34 to 36, St. Lawrence River.



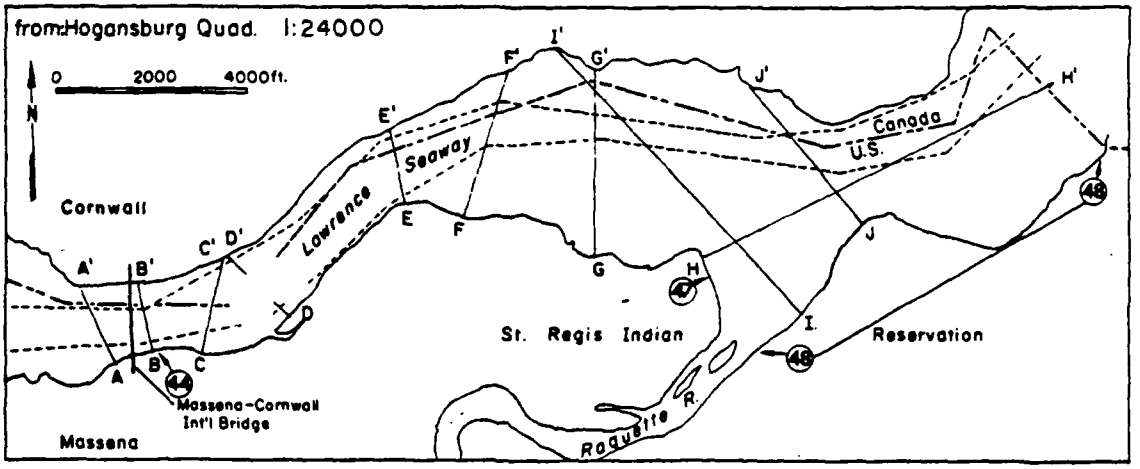
Bathymetry from NOAA Chart# 14761
25th Ed., 24 Sept. '77

Wiley Dondero Canal



(Vert. Exag. 1:25)

Figure D76. Generalized river cross-sections, sites 38 to 43, St. Lawrence River.



Bathymetry from NOAA Chart #14761
25th Ed., 24/9/77

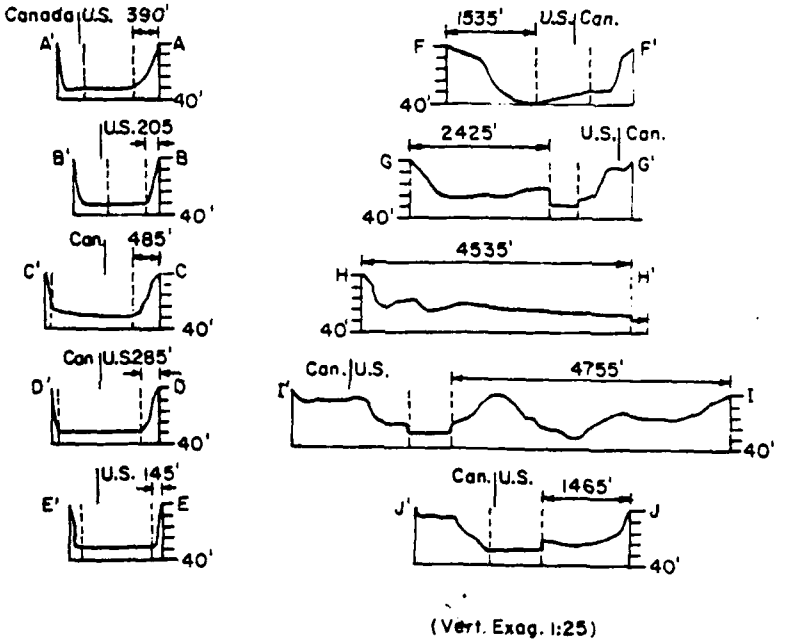


Figure D77. Generalized river cross-sections, sites 44 to 48, St. Lawrence River.